AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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Engines for the Steamboat "Nutmeg State."

With this we give an illustration of a very compact and well-designed triple-expansion engine for the steamboat "Nutmeg State," which is the latest addition to the Bridgeport Steamboat Company's line of steamers, and is now engaged in the passenger and freight service running between New York and Bridgeport, Conn. The H. P. cylinder is 18 inches diameter; I. P. cylinder, 27 inches; L. P. cylinder, 42 inches diameter; stroke, 28 inches. At the front side the cylinders are supported by three wrought-iron columns 4½ inches diameter, and at the rear side by three cast-iron columns bolted to the top of condenser, which forms part of the framing. The cooling surface in condenser is 1,600 square feet. A single-acting air pump is bolted to the condenser and worked by a lever, which receives its motion from L. P. crosshead. The diameter of air-pump is 21 inches.

For the distribution of steam in the H. P. cylinder a piston valve 10½ inches diameter is used; and double-ported slide valves perform the same office for I. P. and L. P. cylinders.

Steam ports in the I. P. cylinder are 3 inches wide and 20 inches long; in the L. P. cylinder they are 3 inches wide and 38 inches long.

These valves are actuated by the ordinary Stephenson link motion; the links being of the double-bar type, and the motion reversed by steam. The diameter of the reversing cylinder is 8 inches. The pistons are of cast-iron, fitted with the ordinary cast-iron packing rings held out by steel springs. Diameter of piston rods, 3⅞ inches; diameter of connecting rods, crosshead end, 3⅝ inches; crank-pin end, 4⅛ inches diameter; crosshead pin, 4⅝ inches diameter; crank-pin, 8⅝ inches diameter and 9 inches long; main journals, 8½ inches diameter and 12 inches long; crank webs, 6¼ inches thick and 16½ inches wide. A worm and wheel is attached to the end of the crank-shaft for turning the engines by hand. Diameter of propeller, 9 feet 10 inches; pitch, 14 feet; number of blades, 4. Feed and bilge pumps are worked from the air pump crosshead. The circulating pump is an independent one. The engine develops 1,000 horse-power; total consumption of coal, 1,600 pounds per hour.

Steam is supplied by two cylindrical boilers 9 feet 4 inches diameter and 20 feet long; each contains two furnaces 47 inches diameter. Total grate surface, 100 square feet; working pressure, 160 pounds.

The hull is built of wood: length on water line, 183 feet; breadth, 34 feet; mean draught, 9 feet; displacement, 960 tons.

The accommodations for passengers are very commodious. There are 38 state-rooms and a ladies' cabin on the saloon deck, and 36 berths for cabin passengers below the main deck.

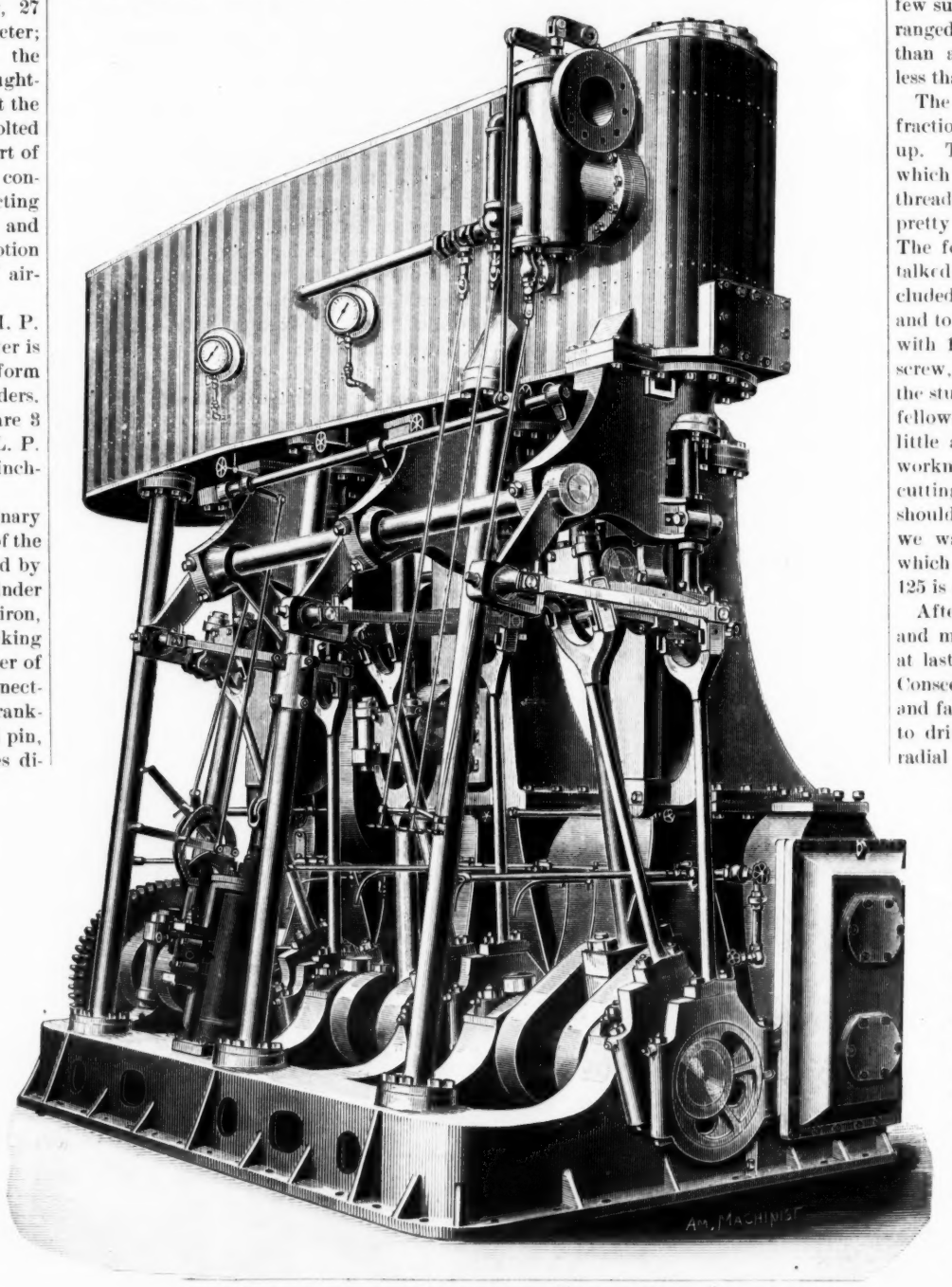
The engines were built by Mr. John W. Sullivan, 384 and 385 South street, New York. The hull was built by Robert Palmer & Sons, Noank, Conn.

Now comes the statement that the Inman Line is to fix upon Southampton instead of Liverpool as its European terminus. For passenger service this might be all right, but for freight it might not be so well.

Shop Practice.

BY ALBERT D. PENTZ.

It was required of an old-time machinist in an old-time shop to cut a screw thread on a cone. The cone was for an instrument having some kind of experimental use, and it was made of brass. Its base was eight inches in diameter and its height perhaps was ten inches. The thread was to be a square one, and the pitch was to be one centimeter relative to the inclination. Now the experience which that little bit of practice gave that old time machinist was considerable, and a description of the snags he struck and the means found to overcome them may be of value to any man; if in nothing more than as a demonstration of the value of planning a job, as far as can be seen, before it is begun.



"ENGINES FOR THE STEAMBOAT "NUTMEG STATE."

The first snag was the getting of the tail-stock spindle over four inches. This was surmounted by making an extension to the spindle. This extension was a casting, L shaped, and it was bored out through the end of one arm to receive the spindle to which it was clamped. The end of the other arm was slotted parallel to the spindle, to be held by the bolt that secured the tail-stock in place. The center was placed in the elbow, and it was situated about 3½ inches in front of the usual center. The other half inch was got by the adjustment as usual. It will be seen that the center in this piece has all the adjustments of the usual center in the spindle with the benefit of an immense deflection. A tail-stock with an adjustment 1¼" each side of the center line has its capacity in this particular increased to 5½", or 10½" in all, the piece being made to be turned over and used back of the center as well as in front.

The second snag was the centers; the lathe had no taper attachment; there were few such twenty years ago. This was arranged by making each center rather more than a hemisphere and reaming the cone less than a hemisphere to fit it.

The next snag that was struck was the fractional pitch, and the old-timer gave that up. The closest he could get was 2½ pitch, which is too fine—that is, there would be 40 threads where there should be but 39.37043; pretty close for an old-timer, but not right. The foreman and the oldest apprentice then talked the problem over, and at last concluded to leave the lathe geared for 2½ pitch, and to put in a compound consisting of a gear with 127 teeth to engage the wheel on the screw, and one with 125 to mesh into that on the stud. These men were simple, practical fellows, who knew all about lathes and but little about mathematics. The way these workmen argued was this: "Here we're cutting 40 threads in a length where there should be but 39.37043 threads, and what we want is a compound, the members of which have teeth in that proportion and 127–125 is close enough."

After these three obstructions were met and mounted the old-timer thought that he at last was at sea and well on his journey. Consequently he put the cone in the lathe and fastened a long stud on the spider plate to drive it with. This stud bore against a radial spoke or arm which was a part of the web in the base of the cone. The old-timer knew that this would give a differential speed to the surface of the cone; but that it would affect the pitch of the screw he had no idea about that. The oldest apprentice, however, had a notion that something would be wrong. He was much respected in the shop, as he had a case of drawing tools, a Haswell, and he subscribed for the "*Scientific*." The foreman didn't see that anything could happen; but the precaution was taken to mark the surface of the cone with a fine pencil-point and measure that with the dividers. No difference in the width of different parts of the spaces was found. The apprentice was silenced. The old-timer adjusted his thread tool and was about to begin to spoil the cone, when the professor, for whom the job was being done, came in to see how it was getting along. The apprentice mentioned his idea and asked the professor his opinion.

"I—do—not—see — what — difference—it—could—ah—let me see. You—are - right—it does make a difference."

"The dividers do not show it."

"That—is—because—the—lines are parallel. The—speed—is—always—fast at the same places, and — slow — at the same places; hence — while — the — lines — are —about equal distances apart—, their—inclinations—to—the—center—line—varies in angle. What—means—have—you—to—di-

Now this old-time machinist was one of that old-time brand, perhaps now extinct, that started to work first, and started to think only when such foolishness became necessary. Then they generally got wrong, because they were not adept at thinking, and if the job was not spoiled before a false theory or a mistake in the calculations was discovered there would be a general consultation, and every head in the shop would be scratched over it.

vide—this—lathe—head—into parts of the circle?"

"This big spindle gear has 60 teeth."

"That—is—good. Place—the—driver—stud on top. Mark—the—cone—with—a—pencil—at that tool point. Turn—the—gear 15 teeth and mark again. Repeat once—more. Now—measure—from—that turned edge.

A half hour was spent in measuring, but no dividers, rule nor scale in that old time shop could find that the proportionate difference was not correct. The method used of getting at this was to quarter one of the centimeter threads on the cone on a line parallel to the center of the cone with stiff dividers, and set other dividers, first on the dividing mark that crossed the thread nearest the faced base of the cone from the indicated thread to that base. Then to scratch that amount out from one end of the quartered centimeter and extra to it. If the other three similar distances should reach this scratch also from the three internal quarter divisions of the centimeter, the pitch would seem to prove correct, which it did. Then the professor stood back and actually scratched his head. This act proved him to be human, and together with the set-back gained him friends.

Then the foreman said: "Every quarter turn which that gear makes the lathe carriage is pitched forward one quarter of a centimeter. Then because that corner on the cone is always the same distance from the spider plate all the way round, the thread cannot show different from a quarter of a centimeter nearer that edge each quarter turn."

"That—is—true," said the professor.

"Then the fast and slow motion don't matter," said the old timer.

"Only that these marks don't quarter the cone," said the oldest apprentice.

"Good," said the professor; "we should have quartered the cone and not the lathe."

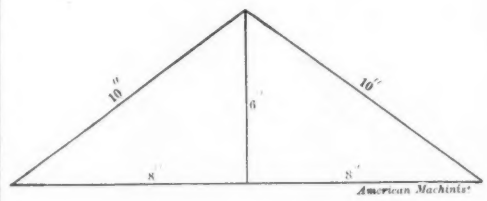
When, with a pair of dividers, the cone was divided into quarters, the variation from the exactness was found to be very great, perhaps the whole variation in both directions was 10 per cent. of the pitch; therefore other means to drive the cone was had. Two bevel gears as large as the cone were made of brass. One was fitted to the base of the cone and the other to the spider plate; then all went well. The apprentice here became further acquainted with the exceeding value of hindsight. For if one of these bevel gears had contained 125 and the other 127 teeth the usual 2½ pitch arrangement on the lathes would have sufficed without a compound. A centimeter is .3937043", or .98426 of .4", which is equal to 2½ pitch. The wheels, therefore, with 125 and 127 teeth in combination with a perfect screw, produce a thread that leads or pitches .39370078 in each revolution, which is within four-millionths of truth.

As I see it, every machinist owes what he has acquired of technical knowledge to the experiences of others in a degree infinitely greater than to his own practice. Therefore when such machinist has in his practice found facts which he believes are not generally known, or sees truths that he believes are not visible to others, it is his privilege, as well as his duty, to make such knowledge known through the best channels open to him. These contributions to the art should be boldly and clearly stated, but without egoism or bombast. So given they will be respectfully received by all those whose opinions are of real value; but if such machinist sets forth statements that are seriously in error, or opinions not in harmony with the facts, it is again the privilege and duty of any one who knows better or thinks clearer, to correct him for the art's sake, and such correction will be well received by any fair person if done in a civilized manner. An attack, however, where the critic's object is self-glorification, or where it is an endeavor to put the author of the original statement "in a hole," for the sole purpose of exhibiting the smartness of the critic, creates only disgust in the mind of the unbiased reader, and should steadily be ignored by the party it is aimed at. At the same time, vigor in a discussion is commendable where such vigor consists of hard blows aimed at error, or the destruction of the fallacies of sophistry by caustic irony, but where a man of straw is set up and demolished with rant and bumption, it is like "a tale told by an idiot, full of sound and fury signifying nothing."

In a discussion with an editorial friend on the question whether the figures of bodies of metal were changed in contour by shrinkage or expansion due to heat, he mentioned a case where in an Eastern shop the engineer was busy on an elaborate calculation, having the object to produce a straight-edge with a skeleton web which should be straight on the edge, at all ordinary temperatures. I subsequently looked into this question and found that among practical men there are no defined ideas on this subject at all. Most mechanics have but crude notions of the practical effects of heat on the contour of their work.

Now temperature does not in the least affect the truth of a straight-edge, or a surface plate, if the metal of which it is composed is a homogeneous one. This may be proved very simply thus:

Suppose a skeleton straight-edge 16 inches long is made of the shape in this figure. In



examining this straight-edge we will suppose it to be made of two right angled triangles of the well-known proportions indicated by the numerals marked on it. The square of the line on the base, added to the square of the line on the perpendicular, equals the square of the line on the longest side of a right-angled triangle. In this case the equation is like this:

The square of the base is.....	64
" " " perpendicular.....	36
" " " hypothenuse.....	100

Of course everybody knows this, but there seems to be something left out of the sense of this statement if it be omitted. Now it is evident if iron expands and contracts by heat so much in each degree and for each inch of bulk, that the sides of this triangle will elongate or contract in the ratio of 6, 8 and 10. Hence if it were possible to contract this straight-edge to one-half by cold or expand it by heat to double its size, in one case each side of the outline would be halved in length, and in the other it would be doubled. If each outline of these triangles were halved in length by contraction they would be 4 inches on base lines, 3 inches on the perpendicular line and 5 inches on the longest lines, making perfect right-angled triangles, thus:

$$4^2 + 3^2 = \sqrt{25} = 5.$$

If each outline were doubled it would be

$$16^2 + 12^2 = \sqrt{400} = 20.$$

In this case also the triangles are perfect, and two placed together so that their perpendiculars coincide their bases will preserve a straight line as in the figure.

It therefore is evident, if in these impossibly extreme cases no variation in angle between the shrunk or expanded triangles is possible, and if here the necessary relations of the outlines to produce right lines and rectangles to each other is a constant one, that no intermediate degree of expansion or contraction can show any such variation; and again it is evident that if a right-angled triangle cannot be distorted by regular expansion or shrinkage, that no other plane figure or solid body can be so distorted. For the interiors of all figures and bodies divide into angular figures and bodies without remainders.

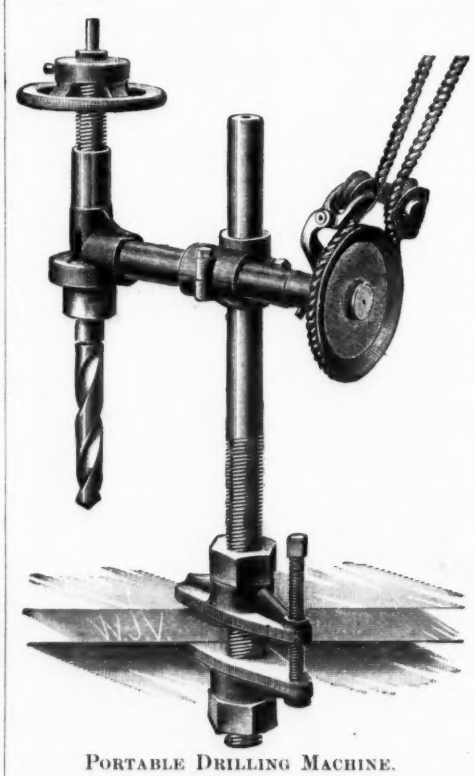
Mr. Francis W. Clough, in July 28th issue, has the elements from which to learn the value of little errors when perhaps they all point in the same direction. If the case be exactly as stated: First, the centers reamed in the arbor are not in dead line. In reaming such centers the arbor should be turned around, or be permitted to turn itself, so that any imperfections in the lathe the piece is reamed in shall be averaged or neutralized. Second, the line center in the turning lathe was probably so soft that its point was bent out of truth by its entrance into the untrue arbor center, yet not to the whole extent of the untruth in that center. Then when the arbor was turned it was made eccentric to the average of one of its center holes. Third, the grinding machine indicated has, or should have, both centers hardened, and means are provided to perfect them after hardening. It is therefore presumed that the centers in the grinding machine touched its point on one side of the hole and farther back at the entrance on the other side. This would grind the arbor to the average of the untrue center hole, perhaps. Fourth, when the arbor is replaced in the turning lathe the bent point of the center might have been detected as well as the untrue center, by the freedom at one part of the revolution and the bind at the other. In turning the arbor on these centers "dead," the bent one acts like a cam or eccentric and disturbs the arbor's truth.

Arbors made as stated should have centers within them 60 degrees at the outer end of the hole and slightly curved outward, and larger than that angle within, so that the lathe centers will bear hard at the big end alone.

I am inclined to think that the centers in the lathe and grinding machine were not exactly of the same length on the points, or perhaps of the same exact taper, or of the taper reamed in the arbor. There may have been a bend sprung in hardening, but that would be indicated to the workman at once when placed on the centers of the lathe. The drilled holes in the centers in the arbor may have been too shallow or eccentric to the reaming. Scale may have formed in the holes in the fire "and so on *ad infinitum*."

Portable Drilling Machine.

We illustrate herewith a portable drilling machine adapted to be driven by power by means of the manufacturer's patented power transmitter, as shown, which can be placed in any desired position.



PORTABLE DRILLING MACHINE.

There are bevel gears inclosed in the case, and thus protected from dirt or accident, these giving the slower and more powerful speeds, while for a faster speed the transmitter is placed directly on top of the main spindle above the feed-wheel, thus driving it direct. To make this change it is necessary to loosen and tighten only one set-screw. The drill can, of course, be operated in any direction, and, by removing the feed-wheel and using a pin in the holes provided for that purpose, the drill may be operated at a distance of 2" from a corner to the center of the drill.

The size of machine shown is adapted for drills up to 1¼" diameter (No. 3 Morse taper socket); has a post 32" long; arm, 11" long; clamps which open 9"; a spindle feed of 5" and weighs 75 pounds. It is manufactured by Albert L. Colburn, New Haven, Conn.

American Boasting.

BY PROF. JOHN E. SWEET.

There is a little consolation in knowing that some of your readers have received a lasting impression from the introductory article on the above subject, and I sincerely hope those who have generously contributed their criticism have read each other's remarks, and received as much pleasure from them as I have. It is to be presumed, Mr. Editor, that all critics have been heard from, and assuming I am entitled to a rejoinder, will, in my defense, confine myself to the points questioned, and this should end the discussion. I resume the subject at this time, as "Mechanic" calls on me to know what it is that is done abroad that we cannot do or tell how it was done. I believe that he refers to my remark about the Corliss engine built by Schneider, and the metal work done in China or Japan. About the engine, it was nothing but an outboard pillow block, exactly a reproduction in every line of a pillow block such as Mr. Corliss himself always used. Of a large number of American mechanics—among the rest George Richards, of London, and F. F. Hemenway, who are well known—none of us could tell how it was made. To be explicit, it was a casting certainly, but whether left as it came from the sand and painted, or whether machined and painted, or whether chipped and filed and painted, we simply could not tell. Whichever view one took there was plain evidence that it could not have been done that way by any means known to us. Perhaps "Mechanic" will enlighten us on that point, but before he begins to do it by guessing I would advise him to wait until he has seen the work.

The Chinese scribes walk the streets carrying and working in their hand small iron shells, having bells within, which tinkle as they go. The object is to cure cramping of the fingers, and to signal their profession and their presence. One which I have is about two inches in diameter, does not vary to exceed $\frac{1}{32}$ of an inch from a true sphere, has no joint or hole in it, nor is there any evidence of a weld. Rolling it in almost any direction the bell will tinkle, and I am told by a gentleman who has cut them open that the bell is made of a steel wire coiled like a corkscrew, with one end welded to the shell. These things (or wonders, according as we look at them) are made by the tramp blacksmith, with a kit he carries on his back, and the toy costs about 15 cents.

The above is given as an item of general interest rather than as a specimen of metal-working, for had that been the aim the Japanese bronzes would better serve as an example.

I was very particular at the close of the original article to say that I might be in error in many of my statements. These may have been among them, and I will not attempt to point out the things done abroad that I think we do not do, as it would lead to further controversy, and the AMERICAN MACHINIST is not large enough, but will, as said before, reply to the specific criticised statements.

You, Mr. Editor, begin by questioning whether a hardened tool steel turret head on a screw machine is any better than a cast-iron one. This is an opinion with which the builders, who are certainly among the leading tool builders of the world, would seem to differ. If any one has ever worn out both, I am willing to take his word, regardless as to whether he be French or American.

"Observer" follows by two articles beginning with the following statement: "I am surprised that Prof. Sweet should have

selected the American automatic *horizontal* steam engine as a shining mark for adverse criticism."

What I said was this: "The greatest improvements in single-cylinder steam engines were American." The most economical and best built horizontal engines are built in Switzerland." "A better built Corliss engine than was ever seen in this country was exhibited at the Paris Exhibition." "There were also exhibited engines better finished than the highly finished Brown and Straight Line engines, with even more difference between the American and Mulhouse than the others." I am egotistical enough to believe my own opinion on the two latter statements as good as any. Plenty of Corliss engine builders from this country had opportunities to see the Schneider engine, and none seem to question the statement, and as to the first claim, the record, so far as I know, stands unchallenged.

"Observer" claims a good deal for Mr. Corliss, which Prof. Thurston pretty effectually sifted, and asks if I claim the girder bed used so long by Mr. Corliss was designed in Europe. I made no such claim, neither did I claim that the modern marine engine frame or the cased casting frames for machine tools were first made in America, and Prof. Thurston could have added that, though Mr. Corliss did use the girder bed, he was not the first to make it. So far as known to the writer, Horatio Allen was first. I will depart from my intention so far as to say that I doubt if Mr. Corliss ever had any greater admirers, or if there are any other two men who would go further to do him honor than Prof. Thurston and myself. But he needs no claims but honest ones; he needs no eulogy from us. "Observer" adds other questions of a similar nature to those answered above, and to which equally easy and satisfactory replies could be made, and he ends by the following: "I think it time that the American public should know that there are real designers, inventors and builders on this side of the Atlantic." One can only wonder if "Observer" ever heard of there being any elsewhere.

Mr. C. L. Redfield combs me down elegantly with his fine eloquence from horse racing and Easter bonnets, and ends up with Alvin Clark, to whom, I doubt, if he ever succeeds in paying higher honor than I have myself; but Mr. Redfield shows no disposition to be honest, as while he claimed for Alvin Clark what is his due, he should also have mentioned that the making of the glass for the great lens of the Lick Observatory was what limited the size, in fact, is the most difficult part, and not the grinding of it; and the glass was made in France. Similarly, he brings out the fact that they are building 390 feet arches at Chicago. The arches at Paris were nearly one-half greater span than any thing that had been attempted before. The Chicago exceeds the Paris by fifteen feet, or four per cent.; and fifteen inches would have answered to say it was bigger. But let it be remembered that the Chicago arches are built on the Paris plan, that is, with pivots at the base and crown; while I have a notion that with the Paris gothic arch it was right, and with the Chicago semi-circular it is wrong; that it is borrowed is a fact that should be acknowledged. Mr. Redfield asks if "mere size is a matter about which any one can be boastful"? and again, "It is highly proper, though, that we make comparisons—comparisons that are just, fair and equitable"! This sounds well when the only things specific that Mr. Redfield has pointed out—which are accomplished facts—are the two above referred to, both having nothing but business as a special merit, and in neither has he given any credit. "Observer" has a second chapter on the little credit English authors give us. Mr. Clark has not given all the American engines a place in his book, it is true, neither has he the English, but he has given one of each of the leading classes and that (if sales are any criterion) the leading ones of their class. Has any American engineering journal given a fraction of the information regarding English practice that *Engineering* has given of American? in fact, is there any American journal that gives as much about American engineering as *Engineering*, of London?

Professor Thurston allows that a man "has a right to boast, if he wants to." Let us see; are we all sure about that? Has one a right to disgrace his family, the neighborhood in which he lives, or the country whose protection he claims?

If the readers of the AMERICAN MACHINIST have any doubt as to the boasting proclivities of the American people which "Observer's" and Mr. Redfield's communications do not upset, perhaps the speech of Mr. Bland—the silver dollar man—before Congress, will clear up the doubt. Calling England—with 250 or 300 millions of people under one ruler—'a baby nation," and France—which could now likely hold her own against any nation of the world—a "liliputian nation," will do for spread eagle samples; all this leads back to the three questions—do we boast? does boasting promote progress, and is it in good taste?

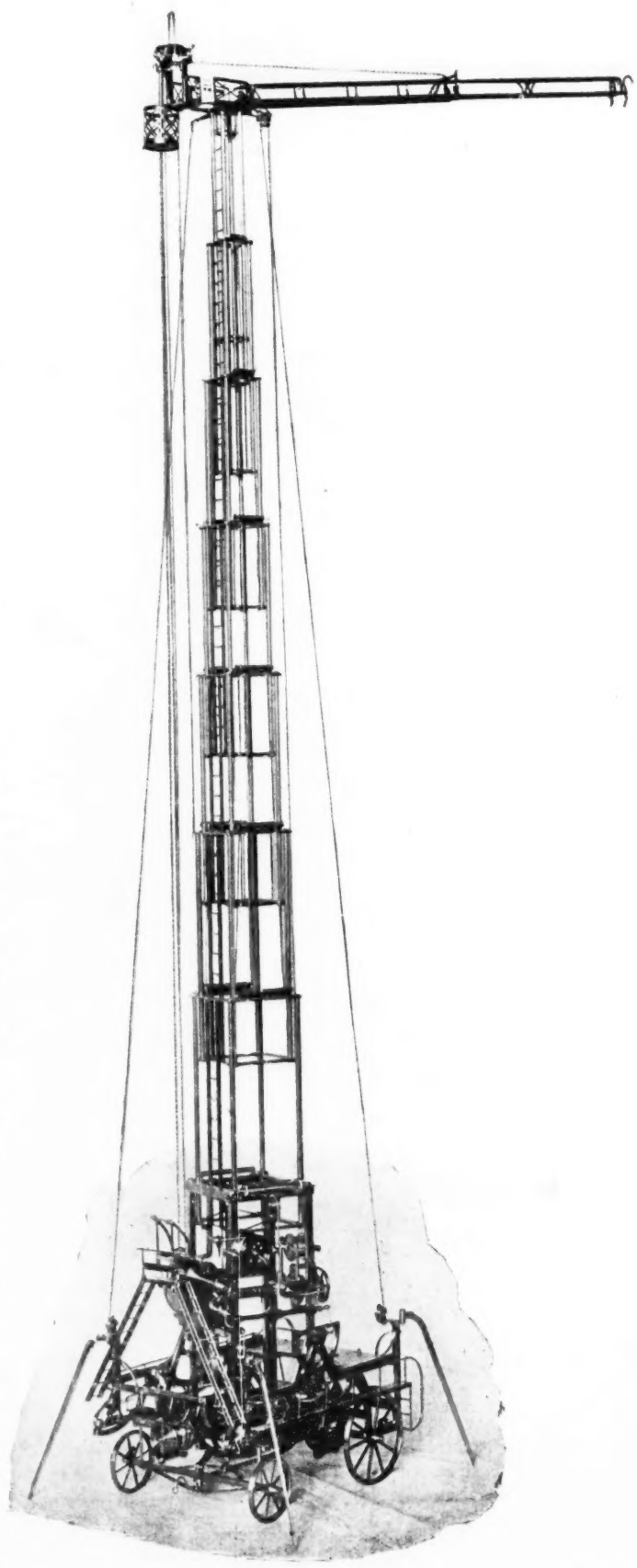


Fig. 3.

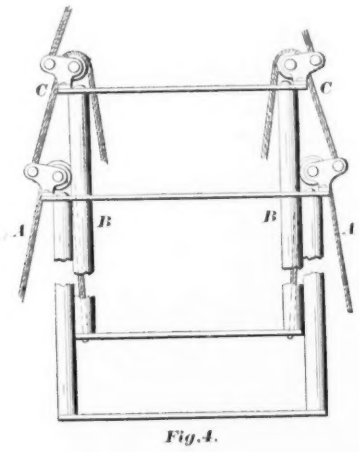


Fig. 4.

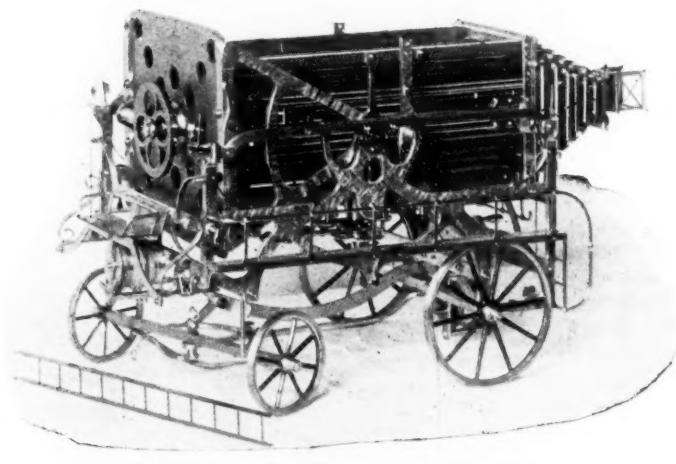


Fig. 1.

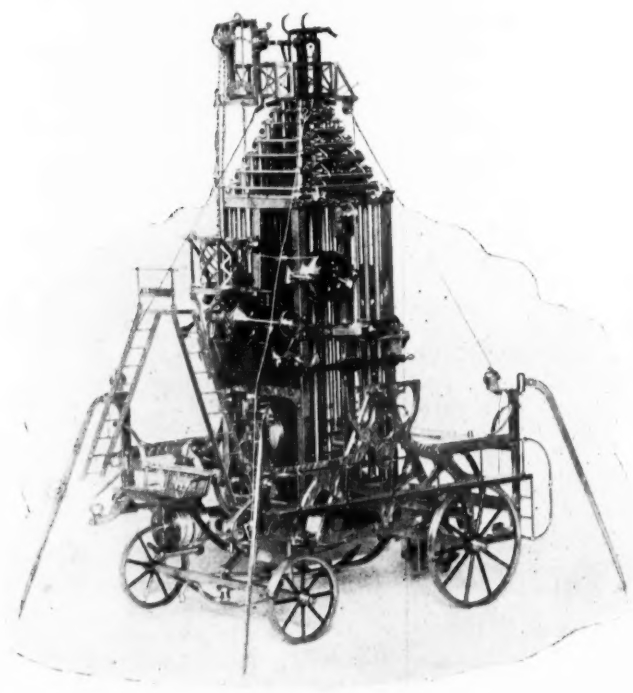


Fig. 2.

A FIRE-TRUCK LADDER.

A Fire-truck Ladder.

Near the top of one of the hills that surround the city of Cincinnati, and not far from where the first steam fire engine was built, lives a mechanic, who, for some years past, has been devoting his spare time to devising and constructing a working model of a machine, by the use of which he hopes to be able to save lives of persons imprisoned in burning buildings, and enable the firemen to work more effectually. A representative of this paper not long since saw this completed model, and inspected the domestic machine shop in which it had been constructed, and three views of the model, made from photographs, are herewith presented.

The main idea of the device, as will be seen, is to provide an efficient fire-escape which can be used for any building, and which can also be used by the firemen in gaining entrance to the upper floors of burning buildings, or for carrying up and using lines of hose.

Fig. 1 shows the machine in its normal state, or as it is intended to stand in the fire department building; Fig. 2 shows it as it appears after arriving at the scene of the fire, and having been made ready for the upward extension; while Fig. 3 shows it fully extended and ready for use. It will be seen to consist essentially of a four-wheeled truck, arranged to be drawn by horses, and supporting a system of telescoping framework which is so arranged as to permit of its being extended upward to any desired height within the limits of the machine by turning a windlass, about which is wound a rope. Each section is provided with a length of ladder, these sections being so related to each other that, as the tower extends upward, they form a continuous ladder, and at the top are two sections which can be extended laterally at any angle, and made to rest upon any desired window or door-sill, so that persons can walk in safety over this, and either climb down the ladder or be lowered to the platform by means of the safety basket, which is shown in position ready for being lowered in Fig. 3, and in its position at the bottom in Fig. 2.

The framework is supported upon a turntable at the bottom, which can be revolved to any desired position by means of the large bevel gear and pinion seen in Fig. 1, and there is also provision for leveling the platform independent of the ground on which the truck stands, this leveling being done the first thing after arriving in position, and placing the four staffs, one at either corner

of the truck, as shown in Figs. 2 and 3, these serving to prevent shifting while the subsequent operations are going on.

Each succeeding section is made sufficiently smaller than the one next below it to go inside of it, the model having the sections composed of tubular corner pieces, though in practice angle-iron would be preferable, because space could be better utilized.

The method of attaching the ropes by which the tower is raised will be understood from an inspection of Fig. 4, where, supposing the ropes *A A* to be pulled downwards by the operation of the windlass, they will, of course, raise the section *B B*, to which they are attached at the bottom, as shown; and this section acting upon rope *C C* raises the next upper section; rope *C C* being attached at one end to the section *A A*, as shown, while the other ends are attached to the bottom of the next higher section, and so on up to the top, all the sections moving together. Safety catches adapted to engage with notches formed in the corner pieces prevent the sections from coming down in case of the breakage of a rope, or by reason of any other accident short of a complete breakdown.

At each corner of the truck are attached guy ropes which reach to the top, and are so arranged that they maintain an equal tension at all times, thus steadying the tower.

The upper or supplementary ladder is in two parts, one of which slides within the other, so that it can be extended to any desired distance within its limits, and there are hooks placed at the end that are so arranged that upon striking anything—such as the side of a building—they are thrown into position to catch upon a window-sill or other projection, and support the extreme end.

The cage is guided and kept in place by a light chain, which extends from the top to the bottom, passing through the cage, which is handled from the platform, and permits persons to be let down in almost absolute safety.

Usually the top of the tower will be above the telegraph wires, but in case it is desired to work through them there is a means of cutting through them.

The mechanism by which all this is accomplished is simple; in fact, such mechanism as has been used for other purposes, and is known to be practicable. So far as can be judged from the model, the tower ought to prove very useful for the purposes for which it is designed. The inventor is Mr. Charles Albert, 35 Clifton avenue, Cincinnati, Ohio.

Milling Cutters Made on the "Rivett" Lathe.

In our issue of July 28th we illustrated a lathe made by the Faneuil Watch Tool Company, of Boston, which was so arranged that the slide-rest could be used as a milling attachment, and when so used would have all the adjustments and movements needed to mill the most intricate forms, except spirals. We now give illustrations of some forms of cutters milled on the lathe, these being not by any means all the forms that can be milled upon it, of course, but typical forms showing the range of the machine. The engravings are full size in every case. Hill, Clarke & Co., Boston, Mass., are the selling agents for the manufacturers.

A Large Milling Machine.

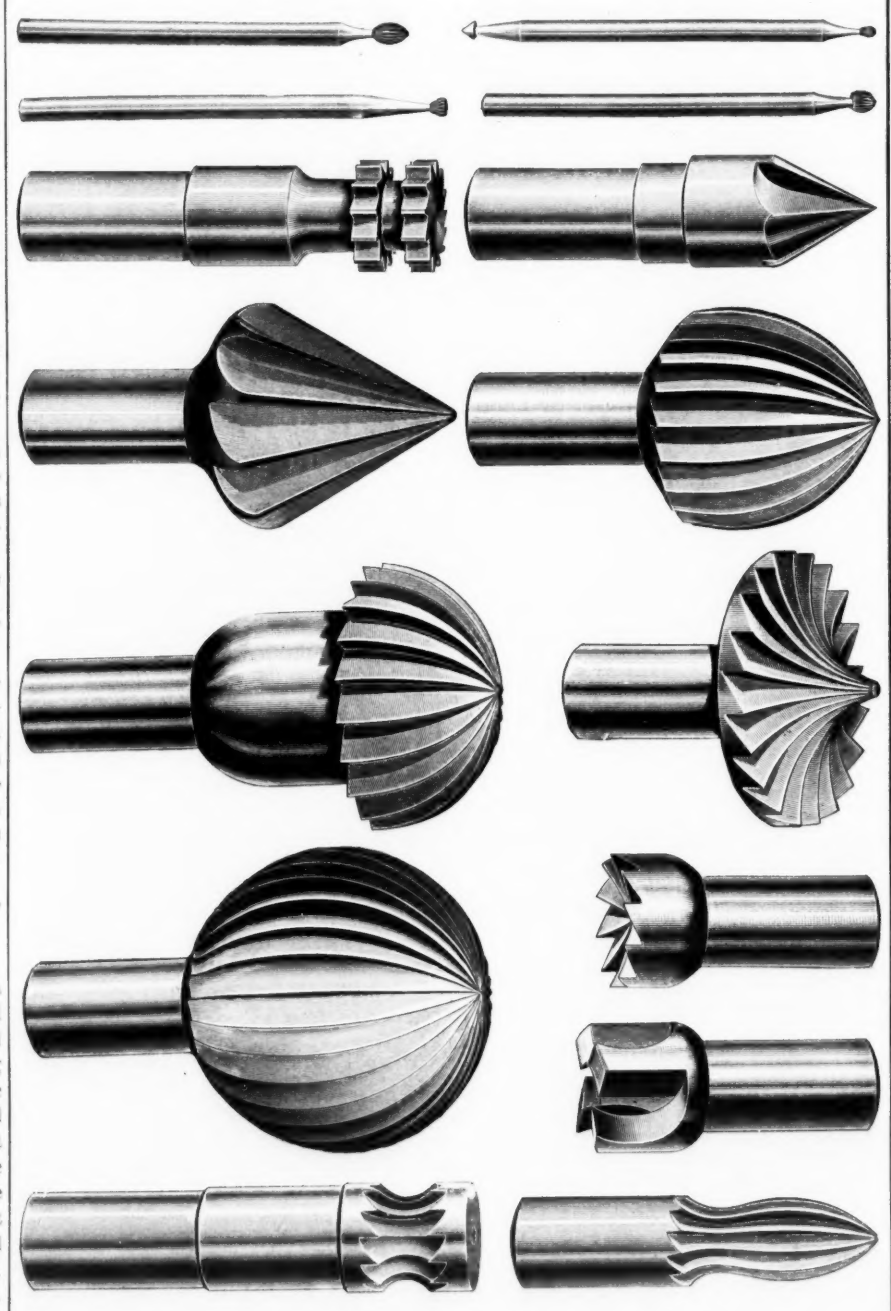
The Ingersoll Milling Machine Co., of Rockford, Ill, are building a milling machine which in general form resembles a planer, and which will mill work 36″ square when using a cutter 6″ diameter. The table is 30″ wide, 8 feet between pockets, which are at either end.

The feed motion is by spiral gears, and has a range from $\frac{3}{16}$″ to 5″ per minute. The spindle is $5\frac{1}{4}$″ diameter, with a bearing 25″ long, and has eight changes of speed, with back gears proportioned 24 to 1. The arbor is 3″ diameter, and has an outboard bearing 10″ long. It has a horizontal adjustment of 14″, and a vertical adjustment of 36″. Cutters 15″ diameter and 36″ long can be used. The cross rail is elevated either by power or by hand, and the screws are graduated to .001″. The machine weighs about 22,000 pounds.

Machine Shop Observations at Fitchburg, Mass.

PUTNAM MACHINE COMPANY.

About the year 1836 J. & S. W. Putnam began the manufacture of machine tools for the market. These brothers started in business at Fitchburg some years previous to this date, all by themselves, as it were, in a little building on Water street, which building, we believe, has been demolished. Their work was principally in the way of doing repairs. Before long they called an apprentice to their assistance—Carter Vanderford—who remained in their employ and that of the company that grew up from their humble beginning, until his death, a year or two since. In 1830, as near as can be determined, the Putnam Brothers built, for their own use, the lathe which we illustrate on page 5 as a relic, and as showing the state of the art at that early period of the machine tool industry in this country. It will be noticed that the bed is of wood, with iron ways screwed to it—a practice which prevailed for some time. Some of these old lathes with wooden beds are still in use in different parts of the country.



Milling Cutters.

It will be noticed that underneath the bed there are tool boxes, typical of the tool receptacles in the hollow columns of many modern machine tools. The small shaft below is the feed shaft, a round belt driving it from the small pulley, as shown. At the right will be seen the feed gears, changes in which brought about change in feed.

As a contrast to this, and as denoting the progress that has been made in the art of building lathes, we need only call the attention of our readers to one of the lathes made by the Putnam Machine Co., and illustrated in our issue of August 4.

As previously stated, the Putnam Brothers did not begin the manufacture of machine tools for sale until about the year 1836. One of the first tools brought out, we believe, was a gear cutter, which found much favor, some of those originally made being in successful use to day.

The tools brought out by the Putnams found immediate favor; they were convenient in operation, neat in design, and of a finish then very popular, but which would, to-day, be considered rather too ornate. The "Putnam" tools found such ready sale that, in 1858 (the brothers had previously moved into larger shops) the present Putnam Machine Company was organized. About this time the well known Putnam steam engine was brought out. This was claimed to be an infringement on existing patents, but the courts decided in favor of the Putnam Company. Since then the company has done an extensive business in the manufacture of these engines, in addition to its business in manufacturing machine tools. The company continued business in the old shops until 1866 or 1867, when a removal was made to the new shops, more room being required for the increasing business.

The present plant of the company covers something more than fifteen acres of land, devoted to buildings and to necessary yard space.

The two largest buildings are the machine shop and the foundry. The former is 625 feet in length and 45 feet wide, with seven Ls or bays. Six of these are 60x45 feet, and one 60x60 feet; one of these is devoted to each of the seven departments into which the machine shop is divided. In these bays machinery is erected and heavy planers are placed.

The foundry is T-shaped, what may be called the stem, or upright, as we would look at the letter, being 160x60 feet, and the horizontal 150x70 feet. This gives them one of the largest foundries in New England. In addition to these are other buildings, such as brass foundry, paint shop, pattern shop, tool room, storerooms, etc., etc.

Besides these shops the company has, since the consolidation with the Putnam Tool Co., an additional shop on another street, 130x45 feet, three stories high, with a large basement and wing.

This brief and incomplete reference to these works will give some idea of the capacity for turning out tools and engines with which most of our readers in this and other countries are familiar.

In a recent visit to the shops we found them very busy on heavy tools, and fairly busy on steam engine work. On light tools there was not so much activity. We noticed under construction a lathe for the Brooklyn Navy Yard. This lathe is 80 feet long between centers, and 74″ swing. It is a "double-header," that is, it has two heads and two foot-stocks; it has three carriages. We shall not, at this time, attempt a description of any of the characteristic features of this lathe, as we expect soon to fully illustrate it.

There was also under construction an 84″ swing lathe, but not so long as the government lathe.

A noticeable feature of the Putnam works is the length of time that men remain in the employment of the company. This is partly due to the fact that it is a good place to work, and partly to the fact that the company never discharges a faithful workman because of the inroads of advancing years. The writer had means of knowing something of the shop force of this company thirty years ago, and was surprised in his recent visit to see so many of the "old hands" still at their posts. It is a practice—this retaining of elderly men—so opposed to that of the more customary practice of sending men adrift after getting the work of a few of their younger years, as to deserve this brief mention. There is little danger of strikes where such a spirit, with other sentiments sure to accompany it, prevails.

It was noticed that the management is alive to the necessity of devising new methods of doing work that shall cheapen the cost of product without infringing on its character as to quality. This is in the direction of the progress that must form part of the history of any machine works that makes a success in these days of sharp competition. Some of these methods we hope to refer to in the future.

In the planing of the three sections of the Brooklyn Navy Yard lathe, to which reference has been previously made, the effect of expansion came vividly to the front. Although the work was done with the utmost care as to accuracy, difference in temperature when measurements were made came in, with its consequent annoyance and interference.

At the present day it is not common for the rather primitive ox to play a part in machine construction. But we noticed in the instance of the Brooklyn lathe that in scraping the ways a yoke of oxen were used for the purpose of dragging a head-stock forward and backward over the ways, to indicate to the fitters where to use their tools. It may be mentioned that the lathe was being erected under a temporary cover in the yard, so the ox can hardly be called a "shop hand."

THE GRANT ANTI-FRICTION BALL CO.

About one year ago John J. Grant and his son Robert started in the manufacture of balls for ball bearings at Fitchburg, Mass. John J. Grant had had experience in that line of work, and believed he could put into practice improved methods of manufacture by which the cost should be lessened and the quality improved.

Later on a stock company was formed, with a capital of $100,000. The Grant Anti-Friction Ball Co., John J. Grant Pres. and General Manager, Robert H. Grant Manager Sales, Nelson Sawyer Supt. At the present time the works consist of a building 30x160 feet, with an addition for a boiler room. The shop is now being equipped with

machines, the progress so far made in this direction being such that 15,000 balls per day can be made, and a force of 20 mechanics are at work on more machinery, the intention being to increase the capacity to 1,000,000 balls per month during the next thirty days; and eventually to make this the largest Anti-Friction Ball Co. in the world.

The machines are entirely automatic in their operation. The balls are turned from long rods of special steel, which are fed along as the cutters form the balls, the operator having little to do; still he must exercise skill in occasionally adjusting cutters, and must supply the machines with rods upon which to do their work.

Of course, in addition to the work of turning is that of hardening and grinding, assorting, etc.; the operation of turning is only the beginning of making the perfect ball.

The balls made by the process of turning from the rod are said to be of most excellent quality, being naturally free from holes.

By the process of grinding and assorting, balls are furnished guaranteed to be within $\frac{1}{5000}$ of an inch of exact standard. This is where special requirements call for that degree of accuracy; for most purposes such accuracy is not required, but it is said that this can be exceeded if called for.

For the most part the balls at present made are of sizes used for bicycles—$\frac{3}{16}''$, $\frac{1}{4}''$ and $\frac{5}{16}''$, but the company expect soon to be able to furnish them from $\frac{1}{32}''$ to 3″ diameter.

Balls are also made from a metal that is termed at the works—alluminoid; these balls are said to possess remarkable strength, so far as crushing or breaking is concerned.

The company are sole owners of the N. Sawyers process for tempering the balls, whereby it brings the liability to water crack the article tempered to a minimum; in fact, a cracked or flawed ball has not been found in all their trials, over 4,000 bicyle balls having been broken for this test. Eminent mechanics who have seen the process have pronounced it perfect.

All balls made by this company are automaticaly gauged, and automaticaly tested for strength.

Besides the machinery used directly for making balls, the shop is provided with a machine shop outfit—lathes, planers, milling machines, drills, etc., used only in the construction of new machines.

The machinery is driven by a 40 horse-power "Southwark" engine. In arranging for driving the ball-turning machines, the plan of putting up separate countershafts for each machine has been avoided, one shaft extending over a row of ten machines driving them all; this requires only one belt from the line shaft instead of ten.

All the machinery has been skillfully designed and constructed, and appears to do its work with great accuracy.

CHARLES H. BROWN & CO.

The senior member of this firm was formerly connected with the Putnam Machine Co., having left that company some thirty-five years ago—more or less—to start in business alone, or more by himself, at least. The company has occupied its present shop for about fifteen years, and their engines are known all over the world. For excellence of finish and for smooth running this engine has never been excelled. The shop is commodious, and well arranged for building steam engines, which is practically the only product. It is three stories in height—two plain stories and a mansard story. On the first or lower floor all the heavy work and erecting is done, the second story being devoted to lighter machine tools and to pattern making, while the mansard story is used for pattern and other storage.

We noticed several engines under construction, both simple and compound. Mr. Brown has brought out a new valve gear, differing quite materially from his usual construction, which we hope to illustrate in an early issue. An engine fitted with this gear is at present driving the machinery of the shop, and runs very nicely indeed.

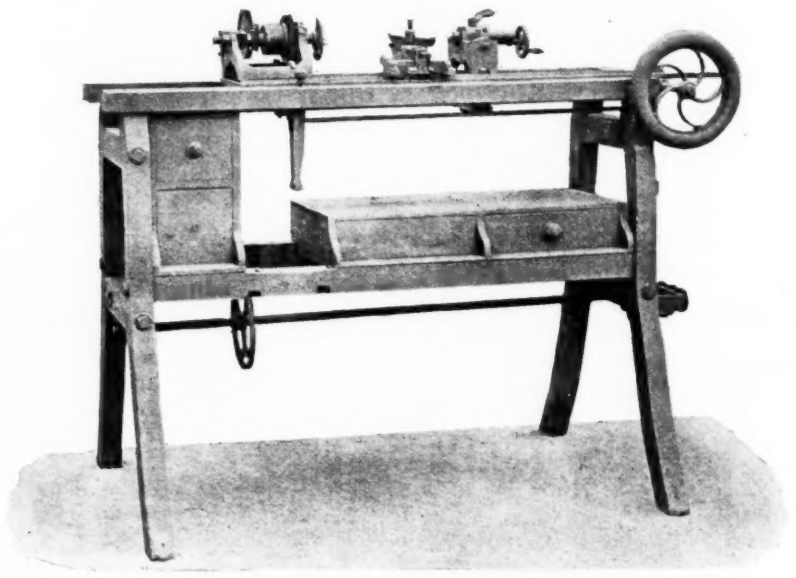
Business appears to be very good, with good prospects ahead. The firm has gone into compounding, which is what all engine builders must come to, sooner or later.

Mr. Brown has devised a plan for putting together large fly-wheels, made up of segments, that appears to us the best we have yet seen. He makes the hubs in two pieces, each of which is bored taper about $\frac{1}{8}''$ to the foot, we should judge, the seat on the shaft being turned to the same taper, both ways, of course. The seats for the arms in the half hubs are machined, as well as the part of the arms that fit in these seats. Then when the two half-hubs are placed on the shaft, with the arms in place, and the whole drawn up by the through bolts, the arms are pinched tightly, and at the same time the hub embraces the shaft, making such a fit as will not permit the slipping of the wheel in either direction, unless from a total collapse.

We also noted that the cylinder patterns used by the company were so constructed as to readily permit the use of one pattern for different lengths of stroke. The prints are made long enough for the longest probable stroke, then the center part, longitudinally, is made to complete the length desired. This saves a good deal of expense in the way of making patterns.

FITCHBURG STEAM ENGINE CO.

This company, having grown beyond its quarters, has erected new shops, into which a removal was made last April. These new shops comprise a main building 150x70 feet,



PUTNAM LATHE OF 1830.—SEE PAGE 4.

with a supplementary building for blacksmith shop and boiler house.

The main building is two stories, 150x70 feet, of brick, and is built in accordance with the New England mill practice—single floors, etc. The second story is the machine shop proper, although there are already several heavy tools on the lower floor, and everything points to the probable fact that this floor will soon be occupied by heavy tools, and that the inevitable stretching out will come. This the company has wisely provided for by placing their building far enough back from the street to permit such a liberal extension in front as will cover at least immediate needs.

On the lower, or main floor, is the office—large, light and airy—the drawing room, a large fireproof vault for books and drawings, and other necessary or convenient rooms.

In the drawing room the drawings are kept by the book index system, and in such a way as to be come at with the least practicable delay. Two sets of blue-prints are made from each drawing, one set being deposited in the fireproof vault.

Besides the office, drawing room, etc., on the lower floor, there are, as previously mentioned, several large tools and storeroom for castings and other material.

The machine shop proper is covered by a traveling crane, which, through convenient traps, reaches down to the lower story.

An elevated spur track between the main building and the blacksmith shop and boiler house is covered by a trolley from the traveling crane, so that material can be brought from cars directly to the machine shop, or machinery can be loaded on cars with expedition. Coal can also be readily "dumped" into the yard just where it is wanted.

An excellent plan is provided for washing. The water trough is elevated so far as to make it impracticable for direct use, then at each side are flat V-shaped troughs. Every man has his own hand basin, and dips from the clean water in the upper trough to suit his convenience, dumping the dirty water in one of the side troughs, which are so inclined as to carry it away to the sewer.

The machinery is driven by a "Fitchburg" compound engine, which runs very smoothly and evenly. We were informed that at the present time about one-third of the engines built were compound.

Business at the works has been driving and is now good.

THE FITCHBURG MACHINE WORKS.

Business is excellent at these works, overtime being made when the weather will permit. In the exceeding heat prevailing at this writing it is hard work to hold men—and little wonder—to ten hours' work.

Amongst the tools we noticed under construction at these works were thirty-three lathes for the Diamond Twist Drill Co., of Akron, O. A peculiarity of these lathes is that the head and tail stock are mounted on a piece separate from the bed, which piece is fitted to swivel on a pin centrally, longitudinally and transverely located, while the Vs upon which the carriage moves are in one piece with the bed. It will be seen that, when turning tapers, both the head and tail-stock are swiveled, keeping the centers in line, so to speak. Presumably these lathes are for turning the taper shanks of drills. There are also building for the same firm eighteen special milling machines; also fifteen hand lathes. This, with the regular work of the company, keeps things moving lively.

This company moved to its present location about twenty three years ago, and has steadily increased its business, until the present quarters are coming to be considered too limited. There is prospect of a change in construction at least.

When a progressive machine company builds a machine shop there is always the chance that progress will exceed the provisions for it, and this appears to be the trouble with this company. However, the space is well occupied, and the product is large for the space.

This company has adopted the plan of making square-ended centers for lathes. This construction permits getting the gear nearer the boxes, shortening the spindle, or, with a given length, giving more room for cone. In the larger sizes of lathes there is a screw thread and nut on the center for removing it.

The machine shop is two stories, the lower story being devoted to heavy tools, and the upper story to medium and light tools.

LETTERS FROM PRACTICAL MEN.

Aerial Navigation.

Editor American Machinist:

I note what you say in issue of June 30, regarding Mr. Maxim's experiments with flying machines, and am tempted to give some review of his article which appeared in the *Century Magazine*, with some of my own conclusions.

Mr. Maxim's alleged results as regards wind pressures against planes, drawn at low angles through the air, are so much in excess of anything which could be predicted by the old rules, as to be rather startling; thus on page 833 he says his plane of 28 square feet area, placed at an inclination of 1 in 14, which equals a 4-degree angle, carried 53 pounds, equal to 1.9 pounds per square foot, when running at a speed of 3,500 feet per minute, or 40 miles per hour. Referring to Hutton's tables for wind pressures in Box' Treatise on Heat and Ventilation, I find that he gives for that speed of wind blowing *at right angles* to the plate, 6 pounds pressure per square foot, and the coefficient for an angle of 4° from a true feather is .014, then $6 \times .014 = .084$ pounds per square foot, about $\frac{1}{23}$ of what Maxim shows.

The pressure increasing as the square of the velocity, as agreed to by Maxim, there is required to support a pressure of 1.9 pounds per square foot, a speed of no less than 187 miles per hour.

If Maxim is right, then the old wind pressure tables require a very decided overhauling. Mr. Maxim's leading statement is as follows:

Those who proved the flight of a goose about 1 horse-power in energy have figured it on the following basis: Suppose a goose to weigh 12 pounds, the wing surface being only slightly over 3 square feet—the wings alone being the only supporting power while flying. Such a goose would fall through the air, provided it made no motion with its wings, at the rate of about 26 miles per hour, or say 2,300 feet per minute. They claim that the goose in flying must therefore perform work which is equal to raising its body 2,300 feet per minute, or as fast as it would fall if it made no motion with its wings. It is quite true if a plane having a surface of 3 square feet should be loaded with 12 pounds that it would fall through the air at the rate of 2,300 feet per minute, and if air was propelled by mechanical energy against the bottom side of this plane with sufficient force to hold it in equilibrium and prevent it from falling, the energy required to propel this column of air would be equal to lifting 12 pounds 2,300 feet per minute. The conventional unit of energy in England and America is 1 pound raised 1 foot high; we should therefore have 12 pounds $\times$ 2,300 as the energy in foot-pounds, which would be 27,600 foot-pounds in 1 minute of time. Now as it requires 33,000 foot-pounds for 1 horse-power, they claim that it follows that a 12-pound goose flying exerts $\frac{12 \times 2,300}{33,000} = .83$ horse-power. This, however, is wide of the truth. *In my experiments I have found that the advantages arising from moving forward on to new air, the inertia of which has not been disturbed, would reduce the energy required to less than one-tenth part of this, because the air under the wings would not yield one-tenth part as much if the goose were moving forward at a high velocity, as it would if the goose remained in the same position and flapped its wings with sufficient energy to sustain itself in the air without moving ahead at all.* The goose would, therefore, exert no more than .083 of a horse-power, which is rather more than half a man-power, and is at the rate of 144.5 pounds to the horse-power.

There is no new discovery in the "new air" theory; it was a constant stream of new air which caused the pressure in Hutton's experiments, just the same as in Maxim's "aëro plane," and it is new air which gives effect to the wings of a humming bird or a bumble bee without any "aëro planes" at all.

In the quoted statement it appears that the goose falling directly downward with outspread wings attains a velocity of 26 miles per hour; now which goose is likely to find the most undisturbed air in a given time, one falling at 26 miles per hour, or another flying horizontally? It seems to me that in this regard the falling goose would have decidedly the advantage, and in order to bring them to an equality, the flying goose would require to go at the rate of 26

miles per hour, which would be too great for a goose to attempt.

Regarding the possibility of the development of .83 horse-power in the body of a 12-pound goose, I see nothing in it which is incredible. The wild goose has been in training from his youth up for a thousand generations. He is an athlete a thousand times trained, while the tame goose, from lack of training, can only fly a very short distance, and that with great difficulty; yet by hard flapping he raises himself from the ground, and can get over a fence without the assistance of "aëro planes," for he has no time to get any headway, as is required by that theory.

Now if a barn yard goose can raise himself and fly a short distance by main strength, who shall say that his highly-trained cousin cannot fly 30 or 40 miles per day by the same power exercised during more hours? To me it seems as absurd as for the average man, as we see him, who cannot walk two miles in a day without great discomfort, to deny that there ever was a man who could walk 100 in a day. Yet it has been done.

Again there are many birds that we know do their flying without "aëro planes" to help them. A quail rising out of the brush, or notably a humming bird, who will hold himself dead still in the air, then move back or ahead, up or down, or sideways, and nothing seen of his wings but a blue fog around him. Mr. Maxim makes another statement which I challenge as very misleading.

It is quite true that artificial machines do not develop so much power per pound of carbon or food consumed as do animals or natural machines; still the highly concentrated character of the fuel—such as coal or petroleum—employed in artificial machines more than compensates for this difference. It is safe to say that there is twenty times as much energy in one pound of petroleum as in twenty pounds of vegetation, fish, or animal matter.

It is well known that in the most economical engines, say 1.5 pounds of combustible per hour, that but 12 per cent. of the heat produced is turned into work, and in engines working against the atmospheric pressure, such as Mr. Maxim proposes to use, the economy will not exceed 6 per cent. So that if, as has been supposed by some, work is done in an animal by consumption of its fat at a rate measurable by Joule's equivalent, it follows that Mr. Maxim's machine will have only $\frac{1}{17}$ the efficiency that the goose has. A pound of goose grease or fish oil is just as valuable a fuel as a pound of petroleum.

It is interesting in this connection to calculate how many hours a wild goose might fly while consuming one pound of hydrocarbon in the shape of goose grease, the heat value of which is given at 15,000 heat units. The latest determination of Joule's equivalent being 789¼ foot-pounds of work (or say 790, for each heat unit, then. $83 \times 33{,}000 \times 60 = 1{,}643{,}400$ foot-pounds work done per hour; $15{,}000 \times 790 = 11{,}850{,}000$ = foot-pounds of work the equivalent of the one pound of fat. Then $\frac{11{,}850{,}000}{1{,}643{,}400} = 7.15$ = the number of hours the bird can fly, according to Joule's equivalent.

I have, however, very serious doubts whether Joule's equivalent even approximates to the economy of nature; it seems to me likely that mechanical power is obtained in wild birds by some direct process without producing heat at all. Most important of all I regard their wonderful appetites and power of digesting and assimilating everything which they take in. There is no waste, nothing comes away from them but a little water and lime. I have no doubt that a wild goose will readily take 5 pounds of fish every day, and this fish food is pure bone, muscle and fat, and also, according to the late Professor Agassiz, furnishes with its phosphorus brain power, in which way he accounted for the immense brains of Boston people, they being great consumers of fish. They have always remembered the graceful compliment.

A sea gull which one of my boys crippled and brought home became quite tame, but he had to be turned loose again because there were not boys enough to bring fish so fast as he could take them. He weighed 2¼ pounds, and I have no doubt that when exercising in his natural way he could eat a pound a day. I have seen him many a time when a new fish was shown, deliberately empty himself by the mouth of the half-digested remains of a fish taken but two hours before, and rush squawking ready to gorge himself again.

All birds are thoroughly clothed with a covering of down and feathers, which is heat tight and water tight and wind tight, and this is an indication that very little of their fuel is wasted for heating purposes. So much for argument.

Mr. Maxim describes his apparatus as an arm revolving horizontally upon the top of a central post, bearing a small flying machine which passes through the circumference of a circle 200 feet for each revolution. The flying machine consists of an extremely keen-looking screw propeller for driving the machine horizontally, and the aëro plane above, one of which was 12 feet 10″x26″, having 28 square feet of surface. Power was transmitted through a belt to the screw shaft, its amount being measured by dynamometer, and the lifting force of the aëro plane by a connection with another dynamometer.

I now come to the apparatus with which Mr. Maxim measured his power, and, as he

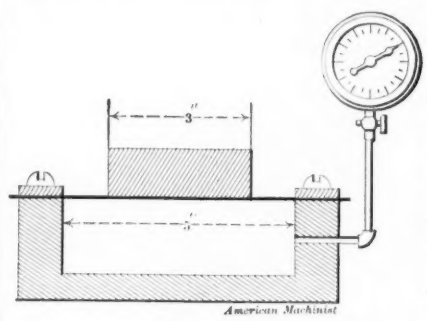
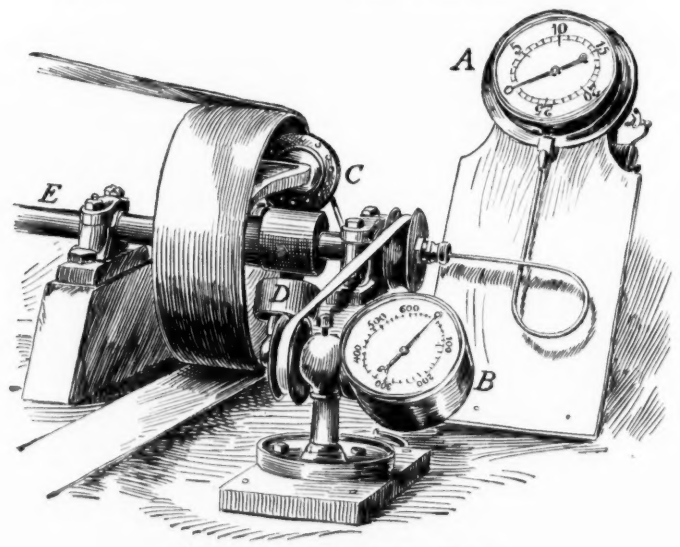


Fig. 2.



Maxim's Dynamometer.—Fig. 1.

makes no secret of its construction, I will thank the editor if he will reproduce the picture on page 834 of the *Century* (Fig. 1.)

The tachometer is not a machine for measuring tacks, as might be inferred from its name, but an instrument for showing the speed, such is the power of the Dutch language.

The cut represents a form of what is improperly termed a dynamometer. They are frequently made with a spring, the extension of which becomes a measure of the pressure applied—exactly as a spring balance shows approximately the weight of butchers' meat placed in the pan—and the work done is found by multiplying the pressure in pounds by the circumference of the circle in feet, through which the point of application of the pressure passes (in the cut the point of application is at *C*, inside the belt pulley) and the product again by the number of revolutions per minute. Mr. Maxim evidently does not believe in springs, as they are hard to connect to, so as to get a reading, so he devised the hydrostatic apparatus shown in the cut, consisting of a short cylinder filled with liquid, and connected with a pressure gauge.

Since the friction of a packed plunger would be too great, he uses a diaphragm with a piston of known area resting against it, making a *very neat looking* arrangement for showing the pressure, but entirely unreliable, as I shall proceed to show at some length, as it has a bearing upon a good many other things besides flying machines.

Any apparatus for measuring pressures which is constructed upon this diaphragm or flexible head principle must of necessity be very uncertain in its indications, as the following little study will show.

Let the sketch, Fig. 2, represent a short upright cylinder 5″ internal diameter, having a solid bottom and a flexible head, which is held in place by a ring and screws, as shown. An ordinary steam or pressure gauge is connected, which shows pounds pressure per square inch. The cylinder and gauge are filled with water, the filling cock shut, and weights are applied upon a plunger 3″ diameter until the gauge reads 100, meaning a pressure of 100 pounds per square inch in the whole interior. Now the question is, How much weight or pressure is there upon this plunger? Suppose this question were published in your Question and Answer column, the answers would come in something like this:

A. says that is simple enough—area of 3″ circle is 7.07 square inches, then $7.07 \times 100 = 707$ pounds.

B. says there is a point midway between the 3″ plunger and the 5″ cylinder where the pressure upon the diaphragm is divided, then the area to be held down is that of a 4″ diameter circle, which is 12.57 square inches; then $12.57 \times 100 = 1{,}257$ pounds.

C. (still more scientific) says half the area of the annulus has to be added to the area of the plunger to get the true area; then area 5″ = 19 64, area 3″ = 7.07 square inches; then $19.64 - 7.07 = 12\ 57$ = area of annulus; then $\frac{12.57}{2} + 7.07 = 13.28 \times 100 = 1{,}328$ pounds.

The pressure on the plunger may be anything or nothing, it all depending upon the amount of water in the machine and the water required to fill up the gauge; a 6″ Bourdon gauge may take half a cubic inch to run it up to 100.

The foregoing shows that if a small amount of water be removed from a pressure-indicating apparatus constructed like that of Mr. Maxim, the readings of his gauge must fall off possibly to nothing, while the actual pressures on the diaphragm might be considerable. It remains for me to point out a good place for the water to escape, viz., the stuffing box on the end of the shaft where the gauge pipe is inserted, and which revolves at 600 per minute.

No matter how much care he may have taken—and he seems to point with pride to the picture, "The experimenter and assistants testing and marking off the dynamometer"—if there was any change in the quantity of the water a new graduation must be made. Again the actual pressure will always be far less than the calculated, on account of the water required to distend the Bourdon tube of the dynamometer.

Mr. Maxim tested his apparatus with a brake and weighted lever on his propeller shaft, and marked his gauge in tenths and hundredths of a horse-power, instead of pounds of pressure, on the piston *C*—at a speed of 600 revolutions per minute for the pulley—of the dynamometer. This is another error, though, of course, Mr. Maxim knows that a calculated result marked on his gauge will only be correct for the exact 600 revolutions per minute; thus, if his shaft were run at double the speed with the same pressure on the dynamometer, the actual power would be doubled, while the indication of the gauge hand would be precisely the same; yet he says, "A dynamometer [recorded] the amount of energy expended." Again he says, "The difference in the readings showed the exact amount of energy required to drive the plane."

Of course a connection can be made for a different speed than the 600 revolutions, but he nowhere says anything about it, and for the average reader of the *Century* it would have made no difference if he had.

Mr. Maxim says:

The steam generator is self-regulating, has 48,000 brazed joints, and is heated by 45,000 gas jets, gas being made by a simple process from petroleum.

I would recommend Mr. Maxim to have a good sand bottom for his ash-pan, so as to save his brass when melting time comes. The neglect of this caused a friend of mine to set his boat on fire when trying a boiler of this construction, and he had only about 500 brazed joints, against Mr. Maxim's 48,000. This "simple process for making the gas" is probably to vaporize the oil on his hot bearings, as there is always plenty of heat on that part of the light-built quick-speed engines such as he proposes. He concludes with the statement that France is to-day the only country which has the scientific and mechanical skill and materials to construct his machine, so I presume it is to France he is going to raise the money as well, and Mr. Maxim shows his good knowledge of the nature of that enthusiastic people—they would tear their shirts off, if they had any, for the privilege of contributing toward the construction of machines for "dropping a ton of dynamite on Berlin."

I never was in France, but the observation of their leading exports—emperors, filthy books, and the Panama Canal—causes me to rate them much lower in civilization than does Mr. Maxim.

William H. Harrison.

Short Talks to the Boys.

Editor American Machinist:

In my last article I set forth the necessity of the young man's reading. But that alone will not make him all that he should strive to be, although it will help to bring forth the last though not the least important quality that he should possess. That quality is *steadiness*, and I might say that it is the most desirable quality that can be wished for.

What is a roving workman worth to the

world, to his family (if he has one), to himself? The answer is, nothing. He does not stay in a town long enough to buy himself a suit of clothes before the old fever takes its hold, and he imagines that he can do better elsewhere, so he leaves that place for another, and so on.

Everywhere he will boast to our boys that he made $5 per day in New York, $6 per day in Pittsburgh, and so on, thereby making them think that as he made such wages there, and is only getting $2 in their town, that they, too, could do better if they were to start "on the road," as he calls it.

Now let's follow our young man, for it is he that we are interested in. We will consider that he is a man of 20 years, that has only partly served his time, and is getting $1 per day.

Going to a neighboring town he chances to get a job by representing himself to be a finished machinist, and is put to work at $2 per day, with the agreement that the wages will be raised as soon as he proves that he is worth more.

I am sorry for him, but that day never came, for before the week was up he had lost his place, simply because he got stuck on a simple job. But he got another place, and soon lost it. After awhile he got used to roving, lost all ambition to better himself, being contented to make a living some way or another, and at last we find him boasting about the high wages that he has commanded, when $2 per day is the most he ever earned.

Of course, there are good men who are compelled to wander around sometimes on account of slack times, etc, but when they do get a job they are pretty likely to hold it, and they will be the last ones to advise you to start "on the road."

Well do I remember when the desire to "strike out" came over me. I wrote to the AMERICAN MACHINIST for advice, and was told to stay at home, which I did, and have lived to thank that kind editor for his advice.

As a parting word, let me ask every young man to work to the interest of his employer, thereby benefiting himself, for such things *will be noticed* Do not go tramping; and read and study, for "theory without practice" is worthless; practice without theory is worth $15 per week. Both combined are worth a world of money.

A PRACTICAL MACHINIST.

Engine Bearings.

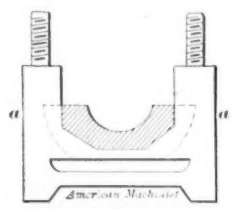
Editor American Machinist:

Bell Crank's experience with engine bearings may, perhaps, be explained by the fact that he attempted to do too good work, that is, work which appeared to be sound and good, and yet all the time neglected some vital point. In his Fig. 1 there is, I take it, an indication of the cause of the trouble which is absent from the successful form of Fig. 2.

Years ago, when a boy set to fit up pedestals for shafting—which was the work first given to boys in the fitting shop—I was carefully fitting the semi-octagonal brasses into the cast-iron blocks, so that they were a touching fit on base, sloping sides and vertical sides *a a*. An old millwright came along and told me I was doing wrong, for when those pedestals were put to work the brasses were bound to become a trifle warm, and thereby to expand against the cast iron which held them, and as the cast-iron was the stiffer piece the brass would close in sideways upon the shaft and grip it tight, and this, he said, they did when so fitted that he had found it difficult to get them free of the shaft, to which they became almost welded by the heat.

The proper plan was to cut away on the sides *a a*, so that the brass could expand from the shaft, and not be forced to expand upon it, and he was right, and I made no more good fits in that line, and never heard of any of my work coming to grief when set to work.

The same trouble, I believe, afflicted railroad bearings when these were once made to embrace half the circle of the axle instead of, as now, so small on arc that gripping is impossible from expansion. Why is it, we may ask, is there so little trouble with car axle bearings, comparatively speaking? Simply

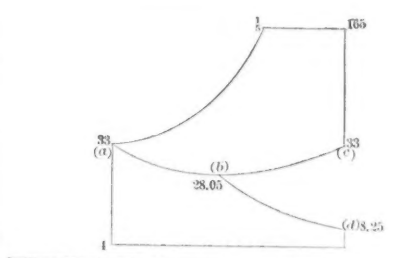


ENGINE BEARINGS.

because they are "badly fitted" to the eye of the unlearned apprentice; they have end play and very little bearing surface, and are at best rough pieces of work, but they serve their purpose, and we all know that different classes of bearings will endure very different load intensities, according as the work through them varies in its application. The crank pin carries a much higher unit stress than the crank-shaft, though not perhaps so much higher as it is often thought to do in the absence of any consideration as to the inertia of the piston-rod, crosshead, etc., and yet the velocity of rubbing is fairly high on a crank pin which has a big diameter, though it loses surface by its shortness. The poor, cheap engine seen by Bell Crank had at least a cap to its bearing which was deprived of much of its power to cause a gripping action, and to such an extent is a better design than the more expensive Fig. 1 type. The same gripping action is characteristic of locomotive bearings, unless provision be made to prevent it. Bearing stresses are usually calculated at so much per projected area of bearing, this area being the length × diameter, but this does not mean that a bearing stress thus obtained, of say 130 pounds per square inch, is a proper figure for a crank-shaft. It does, however, tell us that a proper intensity of pressure per actual bearing is such that it should not exceed what the figure of 130 upon the whole projected area. The actual intensity over the really effective part of a bearing may be 260. Given good design there is no harm in the scraping done by Bell Crank; the trouble is that it was done upon a bad design. It was because of the constant lifting of the crank-shaft in the old beam engines that their bearings always ran so well, though of small area for the load carried.

Until recently Chordal pitch was also given in Molesworth's Pocket-book as correct. How is it possible that any mechanical man can assert Chordal pitch to be correct? The primary idea of a pair of wheels is two perfect cylinders running together in frictional contact, exactly as do now the "frictions" of a sack hoist in a corn warehouse. Teeth added to wheels are, after all, merely a development of a roughened surface given to increase the working power of such frictional wheels. In railroad work sand is put between the wheel and rack to give grip enough to start a train, but no one dreams of running polygonal wheels except that Boston man who did try milling very short flat places on a locomotive drive wheel. Now if wheels are in principle smooth circles running in contact, and having a diameter corresponding inversely to their revolutions, so must toothed wheels be developed from cylinders. The cylinder surface is the pitch circle, and the teeth are but rough places standing equally above and below the pitch surface, and put there not to cause one wheel to drive the other at a different angular velocity from what it would do without teeth, but at the same velocity—that proper to their respective diameters. With Chordal pitch, wheels of different diameters cannot work correctly, and will be often noisy.

In spite of Mr. Crane's correction, I must still adhere to my statement as to cylinder area × steam pressure having everywhere equal significance, for they have. Piston displacement involves some other factor—stroke, length, or speed of revolution. Of course, with a small wheel the tractive force of a given cylinder will be greater, but wheel diameter is largely a question of speed, and dependent very much on the ability of a cylinder to rid itself of exhaust steam at high speeds. A wheel so small that the back pressure becomes very great may exert less rail pull than a larger wheel which can allow a better effective pressure on the piston, and one of the more prominent facts of American practice to-day is the adaptation of larger and larger wheels. Americans seem determined to run some trains as fast as they are run on this side, and they are going the same way to do it, only they have not tried single wheels. The illustration of the English engine on the P. R. R making a slow start is merely confirmatory of what one sees here with compounds. They are not always conveniently stopped for effecting a good start, and as they have only a pair of 14-inch cylinders this is not surprising, but they can pull a heavy train when they are started, and get the 30-inch cylinder working also. Would Mr. Crane say if he found any trouble arising with the use of the brick arch in steel fire-boxes? W. H. BOOTH.



The Compound Engine.

Editor American Machinist:

I have read with interest Mr. Weightman's article in the number of the 28th, and would like to invite discussion about some points not quite clear to me.

In the single-cylinder engine he figures the mean effective pressure quite correctly 28.96 pounds. Now this is purely theoretical, and it is all we can ever hope to get out of the amount of steam that he assumed to go through the engine. How is it possible that he can figure out a higher mean effective pressure (31.374) by using two cylinders? If this were true it would be next to a perpetual motion, because it takes only 28.96 to compress the steam from 8.25 to 165 (if done in a single cylinder), and we would get back 31.374 by using it over again in a compound engine. The mistake Mr. Weightman made is to be found in his ratio of cylinders 1 : 3.35, which should be 4, as he assumes 4 expansions in the L. P. cylinder. With this ratio the mean effective pressure in H. P. cylinder reduces to 53.11 ÷ 4 = 18.273
to which added 15.687
gives the same old 28.96
as the *theoretical* mean effective pressure.

In the following I will try to lay out the theoretical curves of this engine:

At point *a* the H. P. exhaust opens, and the steam exhausts into the receiver, which must have also steam at 33 pounds, to avoid a drop of pressure at (*a*). That is to say, we must place the L. P. cut-off so that at (*c*) the steam is at 33 pounds again. At (*a*) we have a volume of 1 high-pressure cylinder, and the volume of the receiver, which may be assumed as 4 high-pressure cylinder vols. Total = 5 vols. The amount of steam present at this point can be expressed by the product of pressure into volume, or $5 \times 33 = 165$.

Let us now call the point of cut-off in the L. P. cylinder $\frac{1}{n}$, then we have at point (*b*) $\frac{n-1}{n}$ volumes in the high-pressure cylinder, 4 vols. in the receiver and $\frac{1}{n}$ of 4, or $\frac{4}{n}$ vols. in the L. P. cylinder. The total volume occupied by the steam at (*c*) is then $\frac{n-1}{n} + 4 + \frac{4}{n} = \frac{5n+3}{n}$, and the pressure is 165 divided by this volume, or $\frac{165\ n}{5\ n + 3}$.

The final pressure at point (*d*) is $\frac{165}{20} = \frac{33}{4} = 8.25$ pounds, and considering that the curve *b d* is an expansion, or reversed compression curve, we can for a moment let the piston move backwards from (*d*) to (*b*).

At (*d*) we have a volume 4 and an amount of steam of $4 \times 8.25 = 33$; at (*b*) we have a volume $\frac{4}{n}$. Therefore a pressure $\frac{33\ n}{4} = 8.25\ n$. This must be equal to the pressure found before. $8.25\ n = \frac{165\ n}{5\ n + 3}$;

$$n = 3.4 \text{ and } \frac{1}{n} = .294.$$

Having thus ascertained the point of cut-off in the L. P. cylinder we will now trace the correct expansion line. The volume at (*b*) is as follows:

In H. P. cylinder (1 — .294) =	.706
In receiver	4.
In L. P. cylinder (.294 × 4) =	1.176
	5.882

and the pressure is

$$165 : 5.882 = 28.05.$$

At this point, as soon as the L. P. steam valve closes, the amount of steam (165) is divided into two parts—the one that always remains in the receiver and the one that goes through the engine. The value of the latter we know, but it will be interesting to figure it here again. In the L. P. cylinder we have the volume .294 × 4 = 1.176; 1.176 × 28.05 = 33; amount of steam going through engine.

The first is the product of the volume 4.706 into the pressure 28.05, or 4.706 × 28.05 = 132; amount of steam remaining in receiver. At the end of the stroke this whole amount of steam has been pushed into the receiver and occupies now only a space = 4 vols. Its pressure is therefore 132 : 4 = 33 pounds, which demonstrates the correctness of my calculation.

Of course with this point of cut-off the work of the two cylinders will not be the same for each. If this is the condition the actual diagrams must be laid out (allowing losses between cylinders) then the mean effective pressures must be measured and compared, and the point of cut off in the H. P. cylinder shifted accordingly, and new diagrams laid out.

To lay out the curves for a triple-expansion engine is a little more complicated, and I will not do it here, but wait first for the criticism of this article which is sure to come.

F. F. NICKEL.

Setting Over Foot-stocks.

Editor American Machinist:

I have read with interest the article by Professor Sweet on foot-stocks for lathes, but there is one feature that I think the Professor should have mentioned before leaving the subject; that is this:

When a foot-stock is set over for turning tapers, should the spindle remain parallel to the lathe bed as is common practice, or should it always point toward the point of the live center, as it seldom if ever does?

Of course we all know that the taper attachment is the proper thing for turning tapers, and that the foot-stock should never be set over, but so long as builders make them to set over, why not move them in a circle arc. If we have a lathe that will take in four feet between centers, it might be made to turn pieces three feet long, with the tail center pointing directly toward the live center when set over. RIGGS.

A London dispatch says:

The ships San Joaquin and Annie H. Smith, bound from New York for San Francisco, and Seattle and Tacoma, also bark Adolph Olrig, from New York for San Francisco, having encountered unusually severe weather, in which the San Joaquin lost her fore and main topgallant masts, and some sails, the Smith had her rudder head sprung and lost some sails, and the Olrig her rudder head sprung and cargo adrift, have put back to Stanley, F. I.

The Philadelphia & Reading Railroad Company will build a new road between Philadelphia and Cape May, a distance of seventy-six miles, to be known as the Philadelphia & Cape May Railroad. Subscriptions to the stock of the road are conditional that they shall not be paid in until the line is completed.

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Machinery for Tin-plate Manufacture.

If the New York *Evening Post* were less ignorant of the time and labor required to get a line of new machinery—for any manufacturing purpose—perfected and in operation on a large scale, some of its "views" upon the manufacture of tin-plates in this country might be entitled to consideration.

Its latest misfit refers to an order which the American Tin-plate Co., of Elwood, Ind.—an account of the opening of whose new works was published in our issue of July 14—have just taken, through their Cincinnati agents, from Messrs. Norton Bros., of Chicago, for coke tin-plates equivalent to 5,000 boxes, 14x20 inch size, to be delivered within ninety days. Such an order is evidence that the Elwood Works are getting their operations down to a commercial basis. The order is further significant, because of the fact that the plates are all of the lower-priced grades, such as are used in making cans, which it has been said could not be successfully made in this country.

One thing is certain: the plates will be fluxed, before tinning, in palm oil, instead of muriatic acid, as is now and for years past has been a common practice in Wales. The sheets will, therefore, not be rust-breeders, ruining the goods packed in them.

What especially seems to grieve the *Post* is the fact that Norton Bros. should presume to buy any tin-plates, in view of the published announcement as to the success of "their tinning machine by the palm oil process," as the *Post* graphically describes it. The Norton tinning machine now in use at their works has successfully tinned several thousand boxes of "black sheets," and certainly no mechanic will think ten or twelve months spent in perfecting it a long time in which to develop mechanism, such as the last 200 years have not—in Wales—been able to equal.

The trouble with the *Evening Post*, in the main, seems to be, that it does not realize how many distinct mechanical operations are involved in producing tin-plates from the pig, or even from the black sheets. It affects to think that creating an industry of this magnitude is some little inconsequent operation—failure to so create it being proof that it never can be established. It forgets that starting a manufactory of any kind takes time. Especially does it take time when doing so means the building of new works, and the designing and constructing of new machinery. Even when the initial machine is fully developed, it takes time to duplicate it on the large scale required in starting such an industry as the manufacture of tin-plates, especially as several styles of finish in the product, and numerous sizes in each finish, have to be provided for.

As this country consumes fully three-fourths of all the tin-plates made in the world, and as acid-fluxed plates, inaccurately squared and imperfectly tinned sheets, and the inability of American consumers in the past to get any attention paid to their wishes by the distant Welsh producers, have been costing the American people large sums of money, running into the millions, it is to be hoped the *Post* will not continue to make the new American tin-plate industry the sole object of its fury. It should be mindful, also, of the numerous arbitrary advances in the price of tin-plates, from time to time, which the possession of a sure monopoly has enabled the foreign producers to exact from the people of this country, without any compensating benefits to the latter whatever.

Improvement of a Crossing.

Work has been at last fairly begun to better the condition of things at what is now probably as bad as any, if not the very worst railroad crossing in the country.

At the Broad street crossing of the Pennsylvania and Jersey Central railroads, at Elizabeth, the entire through business and a very large proportion of the local business of both roads are concentrated.

The point is only twelve miles from New York, so that every local passenger train made necessary by the vast numbers of people who must be transported daily between the city and the neighboring towns on both roads must pass over it, in addition to which it happens to be at the junction of several streets, one of them the main business thoroughfare of Elizabeth—a city of nearly 40,000 inhabitants. Altogether about 700 trains pass over the crossing daily, which means that during the early morning and later afternoon hours, when the local traffic is heaviest, the crossing is taxed to the utmost capacity of its numerous tracks, and limited trains are often seriously delayed there.

The work of tunneling under the roads for the streets has been going on for some time, and is well advanced, while recently the work of raising the Pennsylvania's tracks has been inaugurated, those of the Jersey Central to remain at the present level. The new station buildings of the latter road are completed, those of the other road being, of course, held back until the work of raising its tracks is completed.

This improvement is one, the need of which has been long seen, but it has been delayed for some years by failure to agree with the city authorities as to terms. The improvement will considerably facilitate the movement of trains, and will probably pay the roads, although its cost will, it is said, approximate $1,500,000.

William P. Trowbridge.

William P. Trowbridge, the head of the engineering department of the School of Mines, Columbia College, New York, died recently at the age of 64. General Trowbridge (we believe he had that title) was one of the best known engineers in the country. He was a graduate of West Point. He served the country through the war of the rebellion. He was a member of many scientific societies, and was one of the thirty men who met in the office of the AMERICAN MACHINIST to organize the American Society of Mechanical Engineers. The cause of General Trowbridge's death was heart failure.

The learned editor of the *Safety Valve* takes us to task for using the word mile instead of knot, when referring to a vessel's run. Perhaps some day—when he has nothing better to occupy his time—he will sit down and make plain to us, and the rest of the world, the exact difference between a knot and a nautical mile, which, of course, is the particular mile always meant when the term is used in connection with the movement of ships. If our contemporary undertakes to do this, he will probably find, when he gets through, that he knows a great deal about the subject of which he is entertainingly ignorant at the present time.

Recently a South Brooklyn ferryboat crashed into her slip under full speed. All the ferry officials refused to say anything about the matter, in which, we think, they were decidedly wrong. It would be beyond nature if such accidents did not occur sometimes, and the wisest plan is to let the public know just why they occur.

In order that any intelligent opinion may be formed, when the statement of the average day's wages paid workmen is made, it should be accompanied by a statement of how many days a man has work in the year, and how many years he is likely to be able to continue his work. These statements, fairly made, would often very materially modify public opinion.

It would appear that many cities in this country delay the payment of money due to workmen till the workmen sell their claims to middlemen at a good round discount. No particular blame attaches to the middlemen. Their operations represent a way of making money as legitimate, perhaps, as many others. But what about the city officials? Is there collusion in the matter?

At this writing there is serious trouble in the mines in Tennessee. The trouble is between the employment of State convicts by the mining companies and the free miners. There is little room to doubt that the employment of convict miners by contractors is bad for free labor, and when the legislature refuses to interfere there is some reason, if not justice, in the interposition of the miners. The people and the soldiers appear to side with the strikers, so called.

A Chicago man whose name would at once be recognized if mentioned, recently spoke to the writer rather forcibly anent the World's Exposition at that city. His complaint was mainly in the direction that New Yorkers and every one else out of Chicago called the fair a Chicago institution. "Why," said the Chicagoian referred to, "this whole fair business is more a matter of New York than of Chicago influence. Chicago," said he, "is an accident in the matter—nothing more." And we think he is right.

Literary Notes.

POOR'S MANUAL OF RAILROADS.—The twenty-fifth annual edition of this standard work has been issued, and it is only necessary to say of it that it is fully up to the standard of former issues, and leaves nothing to be desired in the way of such a publication. No one who has any occasion to keep posted as to railroads in this country, or to know something of their history and operations, especially their financial management, can get along without it. E. V. & H. W. Poor, 70 Wall street, N. Y.

We have in hand the second edition of "Rare and Useful Information for Travelers, Mechanics and Railway Men." The little book contains useful information for every one, and can be obtained from Danks & Co. Chicago, Ill. We are not informed whether or not a price is put upon the book, but can recommend it on general principles.

TREATISE ON TESTING WATER-WHEELS AND MACHINERY. By James Emerson.

The author of this book, who is well known in connection with tests of water-wheels and hydraulic powers, undoubtedly knew much about such matters, but it is very evident that he has much to learn of the art of making books. If Mr. Emerson could have induced some engineering friend to edit his matter for him, and had left out of it all irrelevant matter, about which it is evident the author does not and cannot know anything worth the telling it would have been better. The author has, for instance, views on religious matters which differ essentially from those of most people, and in this book, purporting to treat of hydro-dynamics, he intrudes these views, and even introduces many engravings that are, to say the least, in bad taste, especially in a work purporting to treat of subjects with which these matters have no logical connection.

There is much practical information in the book regarding water-wheels and water-powers, but it is not nearly so available for use as it might be if it were properly edited, arranged, and published without the irrelevant matter referred to. The book is published by the author at Willimansett, Mass. Price, $1.

AMERICAN YACHT LIST FOR 1892.—This is a publication which is of special interest to those who either own or are otherwise identified with yachts, or yacht building and sailing.

It is a superb book of 480 pages, bound in white canvas covers, ornamented in blue, and contains beautiful fac-simile chromo-lithograph illustrations of all club flags and private signals of yacht owners. There is also a complete register of the yacht clubs of the U. S., British Provinces, Royal Bermuda Islands, Royal Jamaica, Habana and Argentino Yacht Clubs, with lists of officers, addresses of secretaries, names of yachts, with official numbers, signal letters, dimensions, designers, builders, etc. Full information is given regarding regattas and races, with rules of measurement, time allowance, etc. There is also an alphabetical list of owners. In the list of steam yachts, for instance, which is in tabular form, the names of the vessels are given alphabetically, with

the official numbers and international code signal letters, the rig, gross and net tonnage, dimensions, character, size and dimensions of engines and boilers, with name and address of builders, names of designers and builders, with date of launching, name of owners, port, and name of club, if any. The several deeds of gift of the "America's" Cup are also given. The book would probably be considered indispensable by most of those interested in yachts who should see a copy of it. It is published by Thomas Manning, 45 Beaver street, New York. Price, $10.

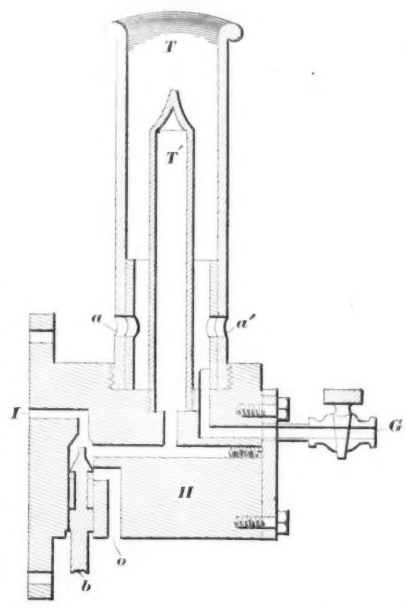
QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(354) A. M., Hoboken, N. J., writes: The valve leather in a pump, after lying still a few days without using, seems to get dry and the air passes through the leather. Now what I would like to have you tell me is what preparation I could use to make the leather completely air-tight—if there is any such preparation existing. I have used lard and glycerine without success. *A.*—Try F. Miller's leather preservative.

(355) A. L. T., Anderson, S. C., writes: I have been in a machine shop for three years, and now I want to learn drawing. Do you think it would be best for me to buy a book of instructions for beginners? If so, which book should I get? *A.*—We believe the articles on "Practical Drawing," recently concluded in the AMERICAN MACHINIST, will aid you in your desire. These can be mailed to you from this office. 2. If you have a catalogue of books suitable for machinists, I would like to have you send me one. *A.*—We do not deal in books, and therefore keep no catalogues for distribution In our issue of February 19, 1891, in an article of "What to Study, and How to Study," we have given a list of books suitable for home study; these you can obtain from any dealer in scientific works; the addresses of some of these are given in our advertising columns. 3. What wages do you think I should get in my fourth year at the machinists' business? That depends altogether on your ability, and the progress you have made during your apprenticeship. Some boys at the end of three years' apprenticeship are worth a journeyman's pay; others are not worth shop-room. 4. What would you advise me to do, after my time is out, go to a technical school or to a good shop, where I can learn modern machine shop practice? Since we are not personally acquainted with you, it is difficult to advise you. Our opinion is that a good technical education is always of great service to a mechanic. If you have the aptitude for such a training, by all means get it, either by studying at home or entering a technical school; the latter course, if you can afford it, will save much time.

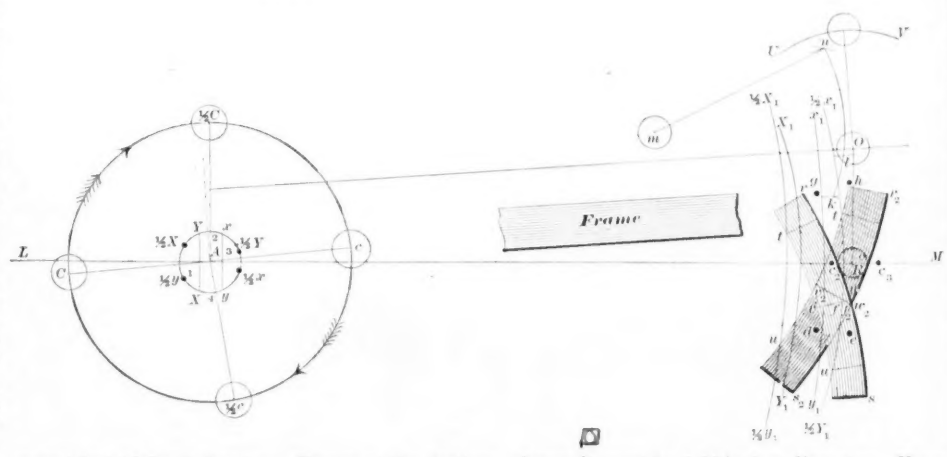
(356) T. G., Brussels, Belgium, writes; We are translating the article on the New Otto gas engines which appeared in your issue of March 17, current volume; but we do not understand the meaning of the following phrase: "Into the tube, kept at a bright red heat, the mixture in the cylinder is allowed to rush by the opening of a small valve, and thus the entire charge is fired at such a time as to give the maximum pressure near the beginning of the stroke." We cannot see how the tube is kept red hot, or anything of the device operating the inlet of the gas mixture or the exhaust after their explosion. We shall feel very much obliged to you for a comprehensive description. *A.*—The accompanying illustration, not drawn to scale, will help to gain a clearer conception of the arrangement. The tube is kept hot by means of a Bunsen burner, into which the ignition tube *T* is inserted; this tube is closed at the upper end as shown, and its lower end is screwed into the cylinder head *H*. The Bunsen burner consists simply of the tube *T* screwed into the cylinder head, the gas is supplied through the pipe *G;* air is admitted through the holes *a a'* to support the combustion of the gas. This mixture is ignited in the tube *T* and allowed to burn while the engine is running, so as to keep the ignition tube at a red heat. This tube has intermittent connection with the explosion chamber by means of the port *I* and valve *e*, which opens at the moment when explosion is required, allowing a portion of the charge from the cylinder to enter the ignition tube *T* and be ignited.



After ignition the valve *e* raises so as to close the port *I*, allowing the unconsumed gases in the ignition tube to escape through the opening *o*, and fresh air to enter while compression is going on in the cylinder. The valve *e* is worked by suitable mechanism on the engine.

(357) T. F. H., Wellington, B. C., writes: We are here engaged in coal mining, and at present are putting in a direct-acting pump. Diameter of steam cylinder, 18 inches; diameter of ram, 8 inches; stroke, 15 inches; diameter of discharge pipe, 6 inches, and 360 feet high; it has two elbows at the bottom. Boiler pressure is 70 pounds. I claim that in calculating the height to which this pump can raise the water, the diameter of the discharge pipe should be dealt with. My friend claims that the discharge pipe has nothing to do with it. Who is right? Please show how a problem of this kind is worked out, and give the percentage to be deducted for friction. *A.*—First find the total steam pressure on the piston; the area of an 18-inch piston is 254.47 square inches; deducting a loss of say 5 pounds from the boiler pressure, we have for the steam pressure in the cylinder $70 - 5 = 65$ pounds. The total pressure on the steam piston will then be $254.47 \times 65 = 16{,}540.55$ pounds. This pressure is transmitted to the ram, which is 8 inches in diameter; its area is 50.26 square inches; hence the ram can resist a pressure of $\frac{16{,}540.55}{50.26} =$ 329 pounds per square inch. The pressure exerted by a column of water one foot high and one inch square is .434 pounds, or, in other words, one foot head corresponds to .434 pounds per square inch. If, now, the whole pressure of 329 pounds per square inch is exerted in balancing a column of water, then the height of this column will be $\frac{329}{.434}$ = 758 feet (fraction neglected). But in raising the water the resistance of friction must be overcome, for which we may allow 25 per cent. Therefore the height through which the pump can raise the water will be $758 - (758 \times .25) = 568.5$ feet. From this it will be seen that the diameter of the discharge pipe has not been taken into account, but the diameter of the plunger can not be neglected. It may be added that if an exact computation of the resistance of friction is required, then the diameter of the discharge pipe must be taken into account, but it seems to us that this is not a part of your dispute; we must, therefore, say that your friend is right.

(358) R. S., Pine Bluff, Ark., writes: The engine of which I send you dimensions uses from 2 to 3 inches more steam in the back end of cylinder than in the front, both in forward and back motion, while the full stroke cuts off square, using an equal amount of steam. In working out this problem I am unable to locate the lifting shaft bearing. The dimensions are as follows: Length of main rod, 7 feet 1 inch; from center of shaft to center of rocker box, 68 inches; lower rocker arm, $8\frac{3}{16}$ inches; upper one, $9\frac{1}{4}$; length of crank, 12 inches; radius of link, 68 inches; link lifter, $10\frac{1}{2}$ inches; eccentrics, 5 inches throw; lifting shaft arm, 20 inches; from center to center of eccentric pin, $11\frac{3}{4}$ inches; eccentric pins back of link arc, $2\frac{3}{4}$ inches; center of axle, 2 inches below the center line of cylinder; lap, $\frac{3}{4}$ inch; lead, $\frac{1}{16}$ inch Kindly give me the location of the lifting shaft and saddle pin to insure an equal cut off. *A.*—The saddle pin should be $\frac{3}{8}$ inch back of the link arc. The position of the lifting shaft is found as follows: Cut a template for the link as shown by the shaded part *r s t u*, the arc *r s* represents the arc through the center of the link, and the arc *t u* represents one which passes through the center of eccentric rod pins, the points *t* and *u* representing the centers of these pins. On this template lay off the position of the center *f* of saddle pin. Let *A* represent the center of the main driving axle; *C*, the center of the crank-pin on one dead center; *c*, the crank-pin on the opposite dead center, and $\frac{1}{2}$ *C*, $\frac{1}{2}$ *c* the positions of crank pin corresponding to half strokes of piston. The small circle drawn from center *A* represents the path of the center of the eccentrics. The points *X* and *Y* represent the center of the forward and backward eccentric respectively when the crank-pin is at *C;* *x* and *y* the same centers when the crank-pin is at *c;* $\frac{1}{2}$ *X* and $\frac{1}{2}$ *Y* when the crank-pin is at $\frac{1}{2}$ *C;* and $\frac{1}{2}$ *x* and $\frac{1}{2}$ *y* when the crank pin is at $\frac{1}{2}$ *c*. Draw the center lines *I O* and *O R* of the rocker arms in their midway position, and through the center *A* and the center *R* of the lower rocker pin draw *L M*, which is the center line of motion of the valve gear. From the center *R* describe the lap circle whose radius has the same proportion to the lap as the length of the lower rocker arm has to the upper one; hence it must be 1.32 inches diameter. From the centers *X*, *Y*, *x*, *y*, $\frac{1}{2}$ *X*, $\frac{1}{2}$ *Y*, $\frac{1}{2}$ *x* and $\frac{1}{2}$ *y*, and with a radius equal to the length of eccentric rod, draw the arcs X_1, Y_1, $\frac{1}{2}$ X_1, etc., to represent the paths of the eccentric rod pins for the various positions of the cranks. Now lay the template on the drawing so that the point *t* will be on the arc $\frac{1}{2}$ *X*, the point *u* on the arc $\frac{1}{2}$ *Y*, and edge *r s* of the template passing through the point in which the lap circle cuts the line of motion *L M;* then through the center of the saddle pin prick off on the paper the point *f*. In a similar way, as indicated by the other position of the template, find the point f_2. From the points *f* and f_2, with a radius equal to length of the link hanger, describe two arcs cutting each other in the point *l*. All that has been done here was to find the positions of the saddle pin corresponding to half strokes $\frac{1}{2}$ *C* and $\frac{1}{2}$ *c;* the arcs $\frac{1}{2}$ X_1 and $\frac{1}{2}$ Y_1 are those in which the eccentric rod pins move when the crank is $\frac{1}{2}$ *C*, and the arcs $\frac{1}{2}$ x_1 and $\frac{1}{2}$ y_1 correspond to the position of the crank at $\frac{1}{2}$ *c*. The next step will be to find the positions of the saddle pin for full gear forward and backward when the crank is on its dead centers. To do so we must take the lead into account. On the line *L M* lay off a point C_2; its distance from *R* must be equal to the sum of the lap and lead decreased to suit the inequality of the length of rocker arms; in this case it will be .71 inch. This point corresponds to the dead center *C*, and the eccentric rod pins will travel in the arcs X_1 and Y_1. Place the template as low as possible with its point *t* on the arc X_1 and the point *u* on the arc Y_1 and the edge *r s* touching the point c_2. In this position prick off through the center of saddle pin on the template the point *d* on the paper. Now move the template to as low a position as possible, so that the edge *r s* will touch the point c_2 (which is also placed .71 inch from *R*) with the point *t* on the arc x_1 and the point *u* on the arc y_1, and in this position prick off through center of saddle pin a point *e* on the paper. From the points *d* and *e* as centers, and with a radius equal to the link hanger, describe two arcs, cutting each other in the point *k*. In a similar way set the template as high as possible, the link arc *r s* touching first the point c_2 and then c_3; thereby find the points *g* and *h*, from which, with a radius equal to the link hanger, two arcs are described cutting each other in the point *n*. Now find a point *m* from which an arc with a radius of 20 inches (the length of the lifting shaft arm) can be described passing as near as possible through the points *k*, *l* and *n;* this point *m* will be the center of the lifting shaft. The whole operation is quite simple, but it takes considerable time, and it can hardly be expected from us to work out a problem of this kind, as our time is limited. For accurate results the drawing should be made full size, or not less than half size. We have confined ourselves to finding the position of the lifting shaft. The method of finding the centers *X Y*, etc., of eccentrics is a problem by itself.



BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

It is a fact. See Grant, p. 20.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

A. D. Pentz, Consulting. Tools. Elizabeth, N. J.

Tool Holder: Armstrong Bros. Tool Co., Chicago. New lists of cutters. Brown & Sharpe.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Holbrook's new loaded rawhide mallets.

Automatic Gear Cutters. Best in the market. Superior Machine Works, 106 Canal St., Cleve'd, O.

Pulley lathes, most efficient offered. Ohio Machine Tool Works, Cincinnati, O.

J. S. Thurman, M. E., Indianapolis, Ind., Expert Patent Solicitor. Inventions Perfected.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg Co., cor. Canal and Washington Sts., Chicago, Ill.

Patterson, Gottfried & Hunter, Limited, 146-150 Centre st., New York, are putting on the market a new alarm speed indicator. Send for circulars.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide. S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

25" } "Only Drill Press built on
32" } 'Ko-rekt' principles,
37" } Even if they come from Jersey."
42" } Gould & Eberhardt, New Ark. N. J.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 205 Broadway, NEW YORK.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

An Experimental Shop at Fitchburg.

Mr. George F. Simonds has a very complete experimental shop at Fitchburg, Mass., in which he is expending a good deal of money in the way of experimenting, in the way of making balls, ball bearings, etc. In our issue of July 28 we published as follows:

BALL BEARINGS FOR STREET CARS.

There has been running on the Fitchburg street railroad for several months a car mounted on ball bearings, which have been in constant use and subjected to the severest tests, and examination now shows that not the slightest evidence of wear can be found on either the bearing surfaces or balls. The bearings were oiled with a few drops of oil at first, and have run ever since without being touched.—*Springfield Republican.*

The above is just the kind of stuff that tends to prevent the use of devices for reducing friction, or accomplishing any desired end in the line of mechanical matters. The wear of the constituent parts of machinery is not measured by "sticks" or picas, and, moreover, any mechanic, however much

be may favor ball bearings, knows that there was wear of both journals and balls, and decently accurate measurements, as measurements are made to-day, would have shown this to have been true. When men start out to write of things of which they have no knowledge, they generally fail to impart information.

This brought out a communication from Mr. Simonds, which we give in part below:

"On page 8 of the AMERICAN MACHINIST of July 28th, I notice an article, Ball Bearings for Street Cars, in which you comment editorially on a statement credited to the *Springfield Republican*.

"I do not hold myself responsible for the language that may be used by newspaper men in describing the work that I am doing, but I can safely say that, if you will come to Fitchburg I will show you some results that will attract your attention, not only in anti-friction bearings but in other directions that will prove of interest to your readers.

"Until a short notice was given in the *Boston Herald*, July 14th, from which the *Springfield Republican* copied, I had permitted nothing to be publicly said in reference to my more recent original work, and July 17th the same correspondent had published the inclosed, which please return to me after reading.

"I am quite well aware that it has been considered an axiomatic truth that where there is a movement of two bodies, on or over each other, there must be friction, and where there is friction there must be wear. I am not prepared to prove that this is not so, but when bearings have run for months doing considerable work, and the oil in said bearing is not discolored, it would seem that, if that point has not been reached, it certainly approaches it.

"During the month of May I employed Mr. Coleman Sellers, of Philadelphia, professionally, to investigate what I have been doing, and report his opinion to me. He was in Fitchburg two days, and has taken two months to get facts from all directions, bearing on the subject. His type written report of ten pages came to me two days ago, and you will find it interesting reading."

When the above item, to which Mr. Simonds refers, was written, we had no idea that he was the inventor of the particular journal bearing to which reference was made. However, that would have made no difference.

In conversation we found that Mr. Simonds believed that we had done him an injustice as regards ball bearings. We went with him to see the bearing to which the *Springfield Republican* evidently referred in its extract, as we quoted.

While we had no means of making a critical examination of this bearing—no data from which to work—we are entirely free to admit that it showed no visible wear. But all this does not change our opinion that there had been wear.

It will be noticed that in the item to which Mr. Simonds refers we did not say that the wear had not been enormously reduced; we contended then, as we do now, that there had been wear.

We pulled a car fitted with these bearings along the track, back and forth, and can testify that there was a wonderfully small effort required to move it. The presumption is that the friction is very slight, and that the wear is correspondingly slight. We believe, however, that there is wear, as we previously intimated.

In Mr. Simonds' shop, which is very complete in its appointments a good many experimental processes are going forward. He says that by processes for grinding balls he can produce perfect spheres, exact to size, and instanced it by holding four $\frac{1}{8}$" balls, selected at random, between the measuring points of a micrometer caliper, turning the caliper over from side to side.

He has also devised a means for hardening balls, and, in fact, other pieces of all kinds, by which the hardening process is continued from brine or water to oil without intervening exposure to atmosphere.

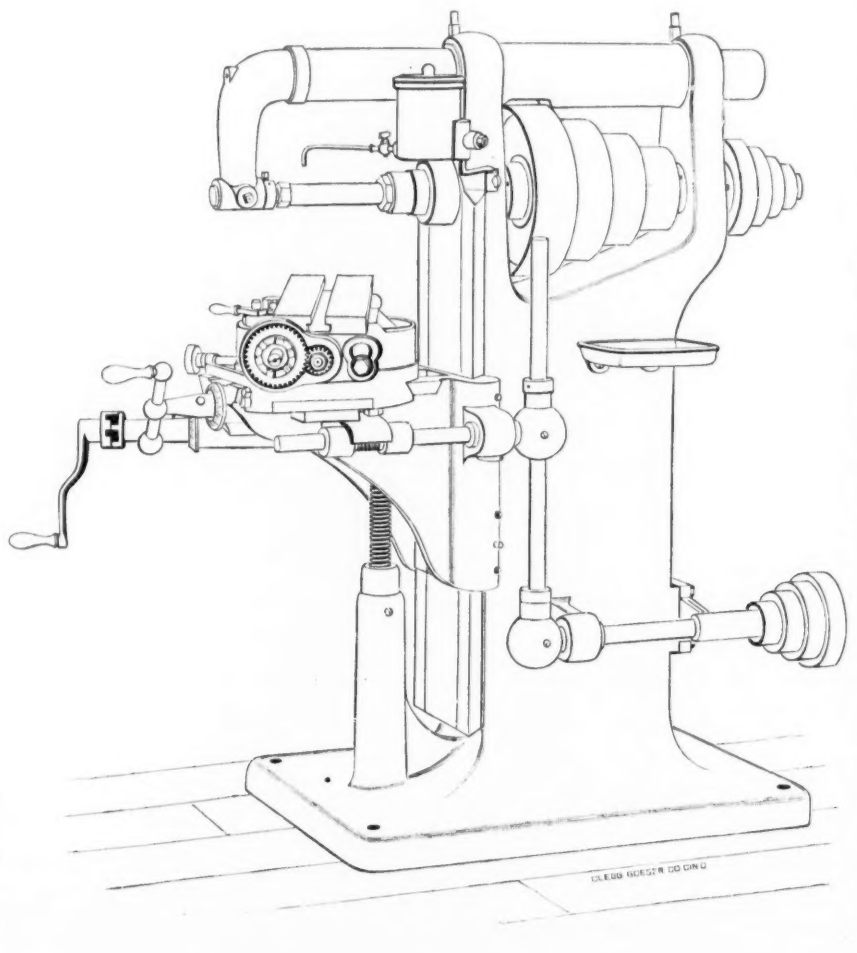
Mr. Simonds' researches also cover a means of using the cementation process by which he makes the outside of a bush or sleeve, such as to harden on the inside or outside, as desired, or to be susceptible of hardening in any of its parts, the other parts remaining soft.

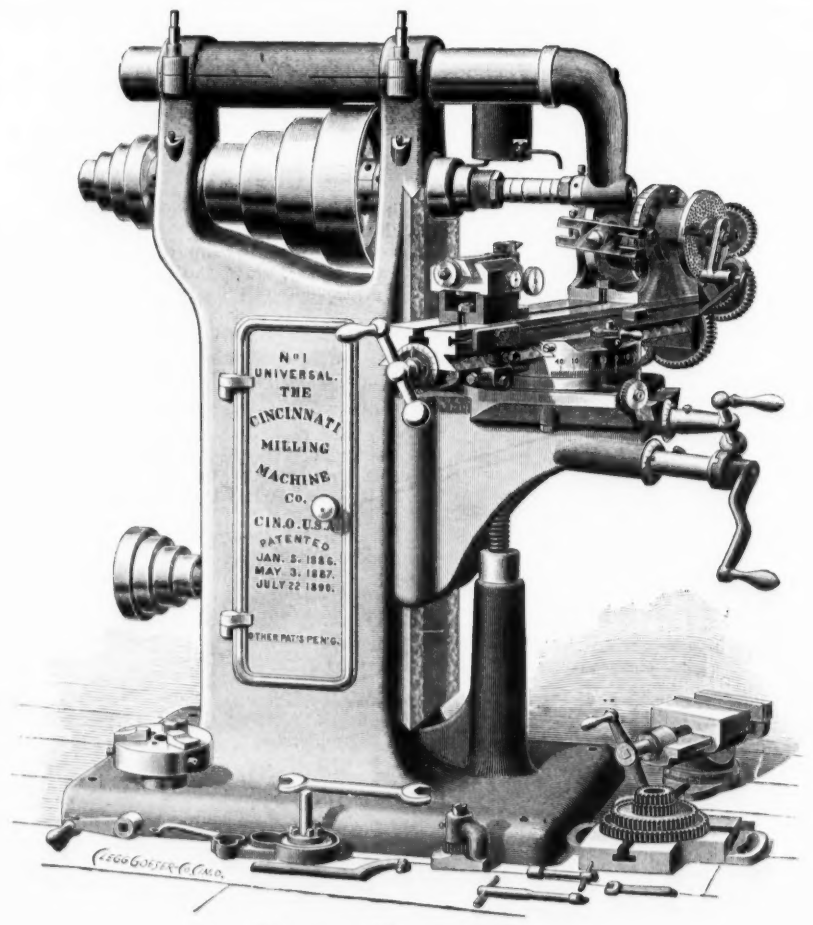
Mr. Simonds claims that by his various processes he can make balls that will stand intense pressure without giving way, and that he can harden steel bushes or sleeves without change of form to any appreciable extent.

Mr. Simonds has devised a large number of adaptations for his various processes, relating mainly to the use of ball bearings for a great variety of purposes. His efforts in this direction are worthy of serious consideration.

Universal Milling Machine.

The accompanying engravings represent a





UNIVERSAL MILLING MACHINE.

milling machine, which has been designed with special reference to the work usually done in a tool room. We have before illustrated machines by the same builders which had some of the features of this one, but were intended for a different class of work, the present machine being somewhat lighter and smaller, though it has good spindle power and is fully as stiff and strong as is consistent with convenient handling on the class of work it is intended for. It will be noticed by referring to the outline view that there are four changes of feed, the motion being transmitted through splined shafts and covered bevel gears to a central vertical shaft, from which the screw is driven.

The base upon which the table rests is circular in form, graduated on its outer face, as shown, and the swiveling plate is secured to the base by means of bolts, which engage with T-slots and lock it firmly in place, these bolts being so placed as to be always in a convenient position. This form of base gives, of course, a uniform bearing at all angles of the table, and there are no projections to strike the face of the column when setting to an angle, thus requiring the cutter to be placed further from the main bearing than would otherwise be the case.

The knee is raised and lowered by a large screw, operated by a horizontal shaft, which is placed at such an angle as to admit of its crank being always in place and ready for use. All movements of the table in every direction are graduated by dials, indicating the movement in .001". The feed works in either direction without change of belt, and is automatically tripped in either direction. The table has a quick-return motion of three to one.

The foot-stock center elevates for taper work, and the head-stock or spiral head swivels in a horizontal plane either side of the center line.

The spindle is of steel, $3\frac{1}{4}$" diameter, and runs in phosphor-bronze bearings, the front one being taper and the rear straight, with provision for taking up wear. A $\frac{3}{4}$" hole passes entirely through the spindle.

The overhanging arm is $3\frac{1}{2}$" diameter, and is clamped over each box, passing through a cylindrical brace which extends from one upright to the other.

Instead of a fixed center to support the outer end of the arbor, it is provided with a hardened steel cylindrical bushing, in which a hardened steel extension of the arbor runs, thus providing a bearing that is durable, allows for expansion, and is in every way satisfactory.

The vise furnished with the machine swivels, and has a graduated base. Its jaws are 6" wide, $1\frac{7}{16}$" deep, and open $3\frac{3}{4}$". Table is 6" wide, 33" long, with an automatic feed of 18". Work $9\frac{1}{2}$" diameter 15" long can be swung on the centers, and a 12" cutter can be used under the arm. The cross motion of the table in line with the spindle is 6", and the vertical movement 17". Slowest automatic feed .0045" per turn of spindle; fastest, .0215". Cone pulley is for a 3" belt, and countershaft is furnished with two friction clutch pulleys. Machine weighs, complete, 2,000 pounds, and is built by the Cincinnati Milling Machine Co., Cincinnati, O.

MANUFACTURES.

Caldwell, Texas, is to have a system of water-works.

Geo. Khrone is erecting a steam gin at Lyons, Texas.

An electric-lighting plant will be established at Lead, S. D.

A system of water-works is being talked of for Coleman, Texas.

The Nashua (N. H.) Hardware Company will erect a new workshop.

The Pittsburgh (Pa.) Roller Car Axle Company is a new $5,000 concern.

The recently burned Loraine (Ohio) Foundry will probably be rebuilt.

The Buffalo (N.Y.) Furnace Co. has incorporated, with $200,000 capital.

George White & Son's machine works at London, Ont., is being enlarged.

Blanks & Gentry will build a foundry and machine shops at South Boston.

The Wire Company at Sycamore, Ill., is talking of erecting an addition to its plant.

The Titusville (Fla.) Electric Light Co. intends to increase its capital stock to $30,000.

The Carse Brothers Manufacturing Company is a new $10,000 concern in Chicago, Ill.

An electric railway will probably be established between Norwalk and Darien, Conn.

The Black Hills Electric Light Company will erect a new power-house at Deadwood, S. D.

The Paducah, Tennessee & Alabama Railway Co. will erect machine shops in Paducah, Ky.

A foundry and machine shop are to be erected at Sulphur Springs, Texas, by R. S. Vanwey.

The Hoffman Iron Works, Chicago, has been incorporated, with a capital stock of $50 000.

It is reported that Salem, Mass., will have a new industry, to employ 200 skilled mechanics.

The Russell Mfg. Co., Higganum, N. Y., is to put in new boiler and engine at its thread mill.

The plant of the Baltimore Electric Refining Company at Canton, Md., will be enlarged.

The Macon & Indian Springs Railway Co. will erect an electric power plant at Macon, Ga.

Machinery is to be added to the plant of the Trion (Ga.) Cotton Manufacturing Company.

The Paducah, Tennessee & Alabama Railway Co. will build machine shops in Paducah, Ky.

A galvanizing department will be added to the Riverside Steel Pipe Works at Wheeling, W. Va.

A steel plant will be erected at Baltimore, Md., to employ 100 men. A new process will be used.

Selby, Stair & Co.'s works, at Peoria, Ill., which were recently destroyed by fire, are to be rebuilt.

The Hudson Electric Railway Co., of Poughkeepsie, N. Y., has decided to erect a plant of its own.

Wais & Roos Punch and Shear Co. has been incorporated in Cincinnati, O.; capital stock, $30,000.

The Wabash will expend $150,000 for new shops at Ashley, Ind., on its new Chicago & Detroit line.

There is talk of a new machine shop in Dover and Foxcroft, Me., to be managed by R. J. Widdis.

The St. Louis Car and Wheel Company's burned plant at Birmingham, Mo., will probably be rebuilt.

The United States Detachable Link Company has been organized at Chicago, with $50,000 capital stock.

The Potter & Atherton Machine Works at Pawtucket, R. I., will be enlarged in either the fall or spring.

The Novelty Manufacturing Co., at Newmarket, Ont., has increased its capital stock from $12,000 to $25,000.

The Indianapolis Car Co., at West Indianapolis, Ind., will resume work about the middle of next month.

The American Elevated Railway Construction Company is a new $1,000,000 concern at Manchester, N. H.

Parties have incorporated the Coplatz Spring Heel Horseshoe Company at Joliet, Ill., with capital $10,000.

The citizens of Mayfield, Ky., are considering a proposition for the establishment of a $180,000 stove foundry.

The negotiations are about complete which will witness the establisnment of bicycle works at Beaver Falls, Pa.

The W. W. & R. M. Keys Company has been incorporated, with $10,000 capital, to deal in metals, at Stratford, Conn.

The Leavitt Machine Company will enlarge its plant at Orange, Mass., by an addition, and will take in 50 new operatives.

The Pope's Island Manufacturing Company, of New Bedford, Mass, has increased its capital stock, and will enlarge its plant.

The Anderson (Ind.) Forging Co., with a capital stock of $30,000, is a recent incorporation. It will manufacture carriage hardware.

The McNeil & Tinder Electric Company will erect a plant for the manufacture of electric recording switch and other specialties.

Muhlhauser & Co. obtained a permit recently for the erection of an addition to their woolen-mill on Pleasant street, which will cost $4,800.

The Westcott Chuck Company, Oneida, N. Y., issue a Spanish catalogue, in which their products are described in the vernacular of that land.

The Illinois Railway Construction Co. has been incorporated by William E. Shaw, John M. Armstrong and William P. Dewey, Jr, of Chicago.

Daniel Best Manufacturing Co., at San Leandro, Cal., has been capitalized at $300,000, for manufacturing and dealing in farming implements, engines, etc.

The National Pump and Machinery Company, Denver, Colo., has been capitalized at $50,000, for manufacturing machinery for pumping water for irrigation.

The Bailey Augur Bit Co., at Harriman, Tenn., has found it necessary to increase its facilities, and it will build an addition to the plant and add new machinery.

An electric light, ice and lumber plant may be added to the Trenton (Tenn.) Foundry and Machine Shop plant, by its new purchasers, Ramsey, Owens & Co.

The Stonewall Phosphate Co., Jacksonville, Fla., is about to put in a new and extensive plant for mining, hauling, elevating, refining and reducing their product.

The Illinois Engineering and Construction Co., of Chicago, has been chartered by John C. Slocum, Edward J. Tenlon and Hamilton S. Wicks; capital stock, $100,000.

The C. H. Hutchinson Foundry and Machine Company, of Manchester, N. H., capital $60,000, is one of the latest institutions to be granted articles of incorporation.

The Yuma Water and Light Co. has been organized at Saco, Me., for the purpose of manufacturing water pumping and electric light machinery, with $100,000 capital stock.

The Southern Manufacturing Company's foundry and machine shop at Eddyville, Ky., have been sold to C. W. Metcalfe, and he will remove the plant to Princeton, Ky.

The Bemis Car Box Company, of Springfield, Mass., is talking of removal to Brightwood, and the erection of a new plant. The question is not fully decided as yet, however.

A company is organizing in Kenebec County, Me., to be known as the New England Weeder Company, which will manufacture a new tool to take the place of the hoe.

Reynolds & Co, are about to enlarge their screw factory at New Haven, Conn. Two additions, one 113x40 feet and two and a half stories, and the other 40x25 feet, will be made.

The Southport Construction Company, with a capital of $500,000, has been organized at Southport, N. C., by H. H. Dougherty, W. H. Pyke and others, to build furnaces, bridges, etc.

The Calvert Brick Company, at Drum Point, Md., will probably want an engine and a boiler. Frank Debelius can be addressed.

George B. Grant, Lexington, Mass., has issued a catalogue of gears for 1892. The catalogue contains a great deal of useful information, and should be in the hands of every progressive mechanic.

A. F. Ward has purchased the Oxford Machine Works at Newcomerstown, Ohio, and proposes to do a general machine shop and foundry work in brass or iron; also pattern making and supplies.

The LeClaire Steel Co, at Belleville, Ill., has been incorporated, with a capital stock of $50,000, to manufacture nails, merchant iron, etc.; incorporators, Jas. C. Waugh, C. W. Stanley, W. M. Switzer,

It is stated that the Baltimore & Ohio Southwestern Terminal Co is to build car shops and roundhouses at Chillicothe, O., for the B. & O. Southwestern system. The plant will cost about $250,000.

The Wilder Manufacturing Company, of Salem, Mass., have removed to new and enlarged quarters, where they will soon begin the manufacture of a new typewriting machine for a New York company.

J. Hoyt Brown, Courtlandt Babcock and Ambrose W. Daynes are the incorporators of the Brown Emergency Link Coupler Co., of Chicago. The capitalization of the company is placed at $2,000,000.

The Cairo (Ill.) Saw and Machine Works has been incorporated, with a capital of $20,000, to manufacture and sell all kinds of machinery and saws; incorporators, Edw. B. Radcliff, John M. Temble, Reed Green.

The Mason Regulator Company, Boston, Mass., issues a watch calendar for 1892-93, two of which will be sent for a two-cent stamp. This can be cut to fit the case of a watch, and will be found convenient.

Herman Nagal, Adam Wagner, Jr., George Hildebrand and others have incorporated the American Wrought-iron Castings Co., of Newport, Va., to manufacture aluminum metal goods, etc. The capital stock is $50,000.

Newspaper reports state that arrangements have been concluded by which the Indianapolis Car Works will locate at South Milwaukee, Wis., the citizens having agreed to donate twenty-five acres of ground and give a bonus of $100 000.

Sweet's Metal Cross Tie Co. has been incorporated, at Los Angeles, Cal, with a capital of $1,000,000, for manufacturing and dealing in Sweet's steel safety cross ties and fastenings, locomotive cars and steamboats, operating iron and coal mines.

Mr. John Conley, late foreman of the Chicago Drop Forge and Foundry Company, and Charles A. Brasch, of Deering Reaper Works, have started a machine shop on South Canal street, Chicago, for the manufacture of dies and special machinery.

The Hancock Switch and Frog Co, of Manchester, N. H., has been formed, for the manufacture of railroad appliances, etc. A. J. Hodden, Samuel G. Lane, J. Whitney Beal, Jr., F. C. Twombly and James C. Lovejoy, of Manchester, N. H., are directors.

There is water-works agitation in Wilkesbarre, Pa.; Orange, Texas; Newtown, N. Y.; Lowell, Mich.; Marshfield, Wis.; Housatonic, Mass.; Minneapolis, Minn.; Lawrence, Mass.; Mt. Vernon, N. Y.; Little Rock, Ark.; Poughkeepsie, N. Y.; South Bend, Ind.

A second large smelting plant has been built at Leadville, Col. This new smelter was erected and was operated by the Bimetallic Smelting Company. It is built to handle a low grade of ore, thousands of tons of which are known to exist in the mines of Lake County.

Gould & Eberhardt, Newark, N. J., write us: "The new foundry which has been under erection for some months was put into operation last week, and with these new and improved facilities for working it will enable us to put our tools on the market as never before."

Articles of incorporation were filed in New Jersey last week by the Nebraska Construction Co, to construct bridges, railroads, etc. The capital stock of the company is $10,000. The incorporators are Eugene P. Janke, Henry Schauffer, Charles O. Kruger and William W. Laughlin.

The Automatic Refrigerator Car Co. has been organized at Portland, Me., to manufacture railroad appliances and rolling stock, with $250,000 capital stock, of which $500 is paid in. The officials are: president, David Dennis, of Gardiner, Me.; treasurer, George G. Hackett, of Wakefield, Mass.

The Union Iron and Steel Co. has been incorporated in Youngstown, O., with a capital of $1,500,000, to manufacture and deal in iron, steel and other metals, operate mines and quarries, and deal in coke. Incorporators, Myron C. Wick, John C. Wick, George D. Wick, W. E. Taylor, Henry Wick.

The Citizens' Electric Light and Power Co., Louisville, Ky., has become a part of the General Electric Light Co., of Boston, Mass., and will hereafter be known as the Citizens' General Electric Co. The new company proposes to erect a large new plant, to which its old machinery will be moved.

The plans of the Great Northern for the machine and car repair shops, stations, roundhouses, etc., to be built at Spokane, Wash., have been completed. The machine shop will have a capacity of seventy-five engines a year, and will employ about 250 men. The buildings are to be finished at the beginning of the new year.

Articles of incorporation of the Southern Steel and Aluminum Alloy Co have been filed at Newport, Ky. Its purpose is to produce, manufacture and sell aluminum and aluminum alloy composites and weldable castings. Its capital stock is $100,000.

The Zell Manufacturing Co. has been incorporated at Baltimore, Md., with a capital stock of $100,000, by Robert R. and Harry L. Zell, Charles L. Hartsfeld, William J. O'Brien, Alan Cole, Charles J. Cary and Frank W. Cole. Its objects are to manufacture aluminum, etc., under Hartsfeld patents, and machinery of all kinds under Zell patents.

The Coe Brass Manufacturing Company are again making additions to their already extensive plant at Thompsonville, Conn., and have placed the contract with the Berlin Iron Bridge Company, of East Berlin, Conn., for three iron buildings, one 32 feet by 130 feet, another 50 feet by 50 feet, and the third 60 feet by 160 feet, these buildings being so arranged as to form a fireproof connection between their several wooden buildings, and thus give additional shop room, and, at the same time, in case of fire, to prevent it from spreading.

Machinists' Supplies and Iron.

New York, August 20, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $15 to $15.50; No. 2, $14 to $14.50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $14.25 to $15 for No. 1 Foundry; $13.50 to $14 for No. 2; and $12.75 to $13.50 for Gray Forge.

Scoten Pig—Coltness is quoted at $21; and $20.25 for Eglington.

Animony—We quote L. X., 11⅞c. to 12¼c. Cookson's, 13c. to 13⅛c; Hallett's, 10¾c. to 10⅞c.

Copper—Lake Copper has been sold at 11.60c. to 11¾c.; Casting Copper is held at 10¾c to 11¼c.

Lead—Demand is quiet. In quantities purchases can be made at 4.10c.; offerings are 4.15c.

Lard Oil—Prime City is quoted at 62c. to 63c.; Western on spot at 61c.

Spelter—The market continues dull, and there has been a decline to 4.70c. for carload lots.

Tin—Sales by the ton for August delivery have been made at 20 50c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—2 1st-class draftsmen. Box 58, Am. Mach.

Wanted—Agents in every shop for machinists' fine tools, sliding calipers, etc. E.G. Smith, Columbia, Pa.

Wanted—Position as foreman pattern maker; best New England refs. Box 56, Amer. Machinist

Mechanical draftsman wants position. Box 57, American Machinist.

Mechanical engineer, graduate, with 10 years' practical experience, wants position in the millwright trade. Address K., American Machinist.

Wanted—Foreman blacksmith on machine tool work. Must be well posted on contract or piece work. Replies to Box 60, American Machinist.

Wanted—Several mach. can have steady employment at good wages. Ottumwa Iron Works, Ottumwa, Ia.

Wanted—Position as traveling salesman by single man; practical machinist; two years on the road; good references. Box 64, American Machinist.

Wanted—Six fitters and lathe men wanted at once; only sober and industrious need apply. Charter Gas Engine Co., Sterling, Ills

Mfrs. Agent—Young, enterprising and aggressive mech. eng. would represent Western firm in N. Y. or travel for mach. builders. Propagator. Am. Mach.

Wanted—Competent foreman for foundry in North Carolina. Both brass and iron. Address Mecklenburg, American Machinist.

Draftsman and designer of machine tools, general and special machinery, and tools for mfrs., desires a change. Box 38, American Machinist.

Wanted—Position as foreman pattern maker; 25 yrs. exp. and 16 yrs. foreman; best econ'e methods; eng. & mach. work; best refs. Box 51, Am. Mach.

Wanted—A position as instructor in a manual training, trade or tech college; wood-work pattern making and molding a specialty; best refs. for practical and theoretical ability. Box 50, Am. Mach.

Wanted—Foreman to take charge of machine shop in Canada, manufacturing stationary and marine engines; none but first-class exp'd man need apply to Box 49, American Machinist

Wanted—By a practical machinist, 15 years' experience, position as erecting engineer and fitter on new plants, marine or stationary engines, first-class marine engineer. Box 65, Am. Machinist.

Technical graduate, holding responsible position with well-known company, wishes to locate in New York City or vicinity. Best references. Addres Box 59, American Machinist.

Dredge engineer is open for a situation; eight years engineer on dredge, twenty years machine shop practice. Best of references. Address Dredge, American Machinist.

Wanted—1st-class man, successful in managing men, and thoroughly acquainted with screw machine work, to take superintendence of a machine screw factory in Western city. Address Queen City, American Machinist.

Wanted—A thoroughly exp'd time-keeper, who can keep time and cost account in shop employing two or three hundred hands. Must understand piece work accounts. State age, salary expected, and experience. Address Box 61, Am. Machinist

All-around draftsman, technical training abroad, 8 years' practice in New York, skilled in the designing of stationary and marine engines able to work out delicate valve gearing and mechanical movements; now employed, desires to make a change. A1 refs. Competent, Am. Machinist.

Wanted—A 1st-class tool maker. One familiar with interchangeable and exact work, tempering, milling, etc. An ingenious, active expert mechanic. Also young man somewhat experienced New tools and light class of work. State full particulars and salary required. Address Box 62, American Machinist.

Situation wanted, preferably in charge of manufacturing shop, by a thorough mechanic, who has had extensive experience in shop management, and is able to manage to produce good results. Also good drawing room experience, designing special and regular machine tools, engines and machinery in general. Box 66, American Machinist.

Bradley Hammers.

If you plate, draw, square, taper, swage, collar, spindle, or do any manner of die forging in iron or steel, a BRADLEY HAMMER will soon pay for itself, by what it will save over any other similar tool. Send for circulars.

BRADLEY & COMPANY, Syracuse, N. Y.

SOMETHING NEW!
NICHOLSON'S COMPRESSION
SHAFT COUPLINGS
W. H. NICHOLSON & CO., Wilkes-Barre, Pa.

STEEL TUBES
WELDLESS
SMOOTH · COLD DRAWN
John S. Leng's Son & Co. New York.

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EXPERIMENTAL ENGINEERING.
By Prof. ROLLA C. CARPENTER, M. S., C. E., M. M. E.
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Providence, R. I.
AN ENGINEERING SCHOOL
Providing one and two year courses in Mathematics, Mechanics, Machine Drawing and Design. Exceptional facilities offered to special students. 6th year begins September 19, 1892. For catalogue and further information apply to
GARDNER C. ANTHONY, Director.

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High Speed, Upright, Horizontal, Marine.
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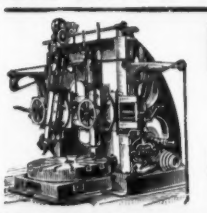

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14 Sizes—From 5 to 20 Feet.
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ASBESTOS CEMENT FELTING,
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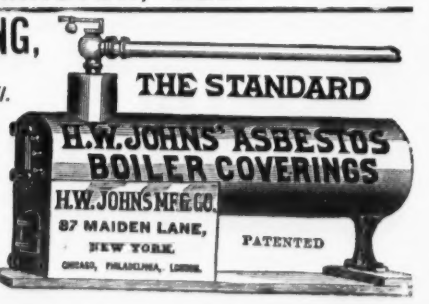
Samples and Descriptive Price List Free by Mail.

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.



Wanted—Superintendent for one of the largest, most progressive and best known machine tool concerns in the United States; will have entire charge of works; none need apply except those now in similar position with one of the standard tool builders of the country; must be progressive, and in touch with the most modern shop practice. For the right man this is the opportunity of his life; much more back of it than can appear in an advertisement; all communications strictly confidential. BOX 31, AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 25 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d-hd lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Presses, Wire Form'g Mchy. Am. Tool Wks, Clev, O.

Bolt Cutter Heads a Spec'y. Am. Tool Wks., Clev., O.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Special machinery designed and built. C. F. Langston & Co., 70 N. 4th St., Philadelphia.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

George D. Slade, dealer in molding sand of all grades, Waterford, N. Y.

Design & superintendence of mach'y. Drawings, etc., made. Claud Mantle, 598 E. 134th St., N. Y.

Wanted—A specialty to manufacture either heavy or light work. We have splendid facilities. Address "Manufacturers," Rockford, Ill.

Agency wanted—A young, energetic mechanical engineer wants to represent some good firms for Buffalo and surroundings. Box 44, care AM. MACH.

Wanted—Hardware specialties to build. Send 2c cents for "Eureka Knife and Shears Sharpener," W. A. Smith & Co., 227 Eddy Street, Providence, R. I.

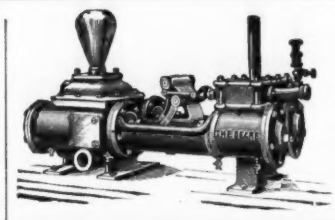
Wanted—A manufacturer to mfg. on royalty and put on the market a new patent fine adjusting caliper. Address A. M., AMERICAN MACHINIST.

Drawing board 3 feet 6 inches by 6 feet with horses; also two vols. of AMER. MACH. 1889 and 1890. For sale cheap. Box 63, AM. MACHINIST,

Bound volumes for 1891. We are now prepared to take orders. Price, $4.00 per volume; express charges payable by purchaser. Address AMERICAN MACHINIST, 203 Broadway, New York.

We will pay 25 cents each for copies of the AMERICAN MACHINIST of December 25, 1886, issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Wanted—Light Machine Work. I have a well-equipped shop, in the upper part of New York City, and should be glad to negotiate with parties wanting light work. Address H. G. P., AMERICAN MACHINIST.



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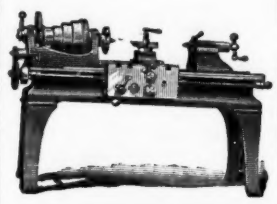

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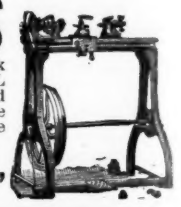

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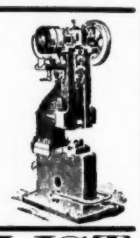

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Send for New Catalogue.

Machine Tools in Stock.

ENGINE LATHES.

78 in. swing,	9 ft.	between centers		Sellers
38 do	17 ft.	bed.	New	Fifield
30 do	14 do		do	
27 do	16 do		do	
24 do	12 do		do	Fifield
24 do	12 do		do	Fitchburg
24 do	12 do		do	Flather
22 do	10 do		New Pattern	Fifield
22 do	12 do		do	do
22 do	12 do		New	Blaisdell
22 do	8 do		do	Flather
21 do	10 do		do	do
20 do	8 do		do	do
20 do	10 do		do	do
18 do	8 do		do	do
18 do	10 do		do	do
18 do	8 do		do	Blaisdell
18 do	16 do		do	do
16 do	6 do		do	Flather
16 do	6 do		do	Blaisdell
15 do	6 do		do	Flather
14 do	6 do		do	do
14 do	6 do		do	Blaisdell
12 do	6 do		do	do

PLANERS.

42 in. wide,	42 in. high,	12 ft. long,	2 heads	Gleason
36 do	36 do	8 do		Pease
30 do	30 do	8 do		do
30 do	30 do	8 do		Whitcomb
30 do	30 do	8 do		Flather
26 do	26 do	6 do		do
24 do	24 do	6 do		do
24 do	24 do	6 do		Whitcomb
22 do	22 do	5 do		do
22 do	22 do	6 do		Flather

SHAPERS.

12, 16, 20 and 24 inch stroke	Eberhardt
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UPRIGHT DRILLS.

20, 21, 25, 28, 30 and 36 inch swing	Prentice
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" 32 in. x 12 ft., c'p'd rest and cross feed.	" "
" 24 in. x 12 ft., Fitchburg. Complete,	" "
" 20 in. x 10 ft., Ames. "	" "
" 20 in. x 8 ft., Perkins. "	" "
" 16 in. x 6 ft., Lathe & Morse. "	" "
" 13 in. x 6 ft., Ames. Special low price. Complete,	New.
Special Lathe, for turning, boring and facing all at same time. Sizes, 26 to 36 in., Ohio Machine Tool Works make.	
Brass Lathes, Turret and Square Arbors.	
Planer, 24 in. x 8 ft., Lathe & Morse, modern style.	At order.
" 48 in. x 10 ft., Bement pattern.	Good order.
Radial Drill, 60 in., Niles Tool Works, late pattern with back gears and automatic feed.	
Upright Drill, 24 in. back gears and auto. feed.	" "
Gang " 3 and 4 Spindles, Pratt & Whitney.	At order.
Improved Universal and Standard Milling Machines.	
Screw Machine, 1 3/8 in. Brown & Sharpe, complete.	" "
" " 15-16 in. Jones & Lamson,	" "
" " 2 1-8 in. "	" "
Profiling Machine, 2 spindle, Pratt & Whitney.	Good order.
Pipe Machine, with full set Dies up to 4 inch, modern style, Morris & Tasker's.	" "
Center Bolt Cutter, 1¼ in., for cutting finished and rough bolts accurately on centers, full set Taps and Dies.	New.
Upright Boring and Turning Mill, 38 in. Improved style.	
Stiles No. 3 Geared Press.	Good as new.
Tool Grinders, Eberhardt & Springfield.	
Boiler Bending Rolls, with latest improvements, hinged housings and balanced top roll. Sizes, 8 and 10 ft., for quick delivery.	
Bridge or Boiler Stationary Riveting Machine, 60 in. gap, with complete overhead hoisting apparatus	
Bradley Hammers, 60 lb.	At order
Large assortment of the latest improved new tools.	

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ENGINE AND SPEED LATHES,
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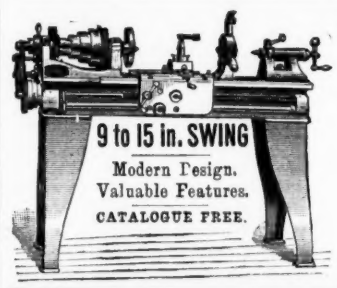

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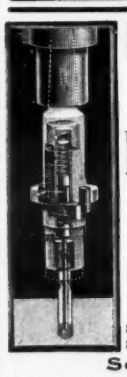

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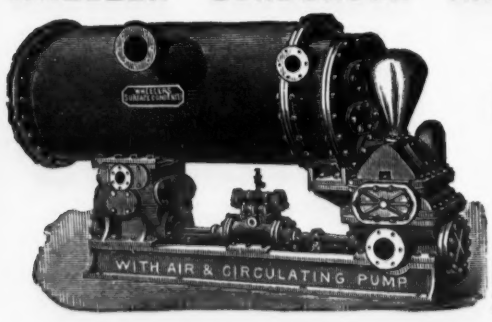

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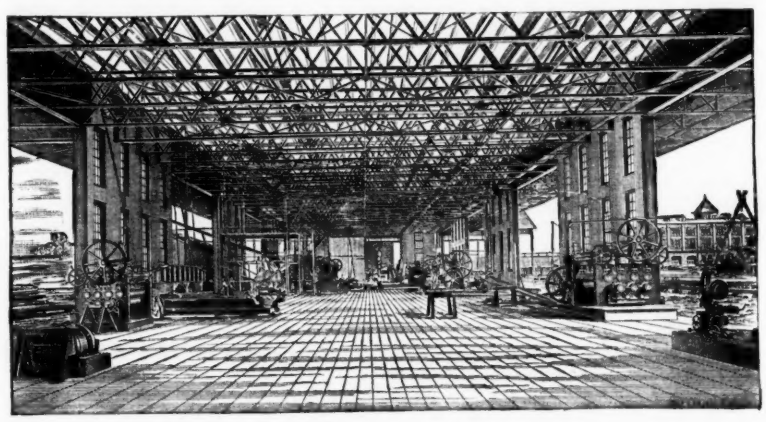

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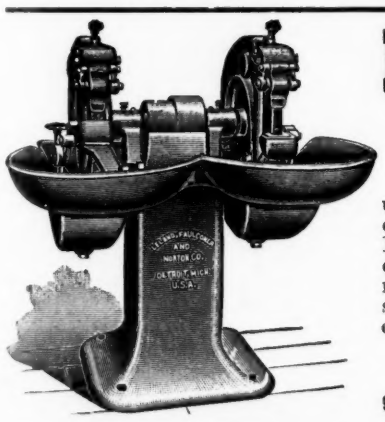

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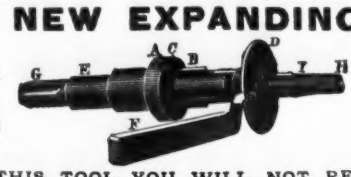

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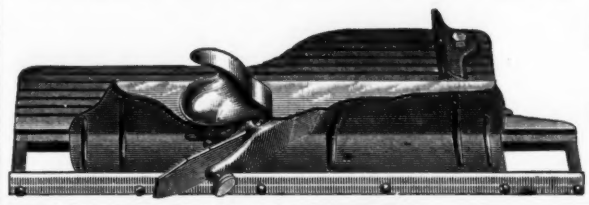

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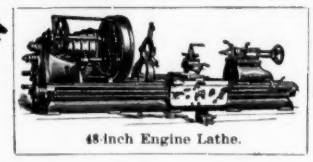

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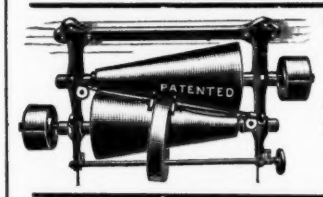

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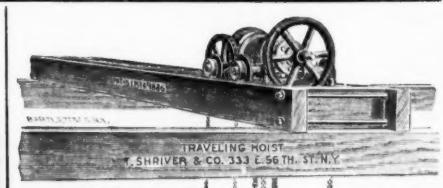

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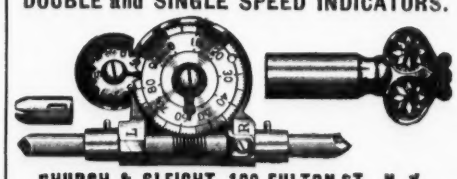

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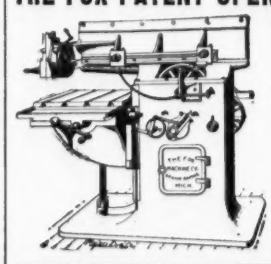

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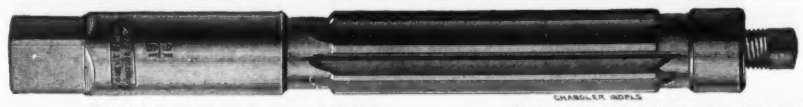

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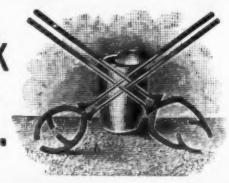

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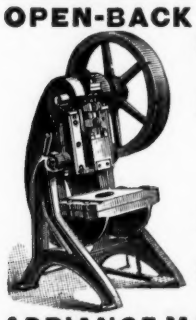

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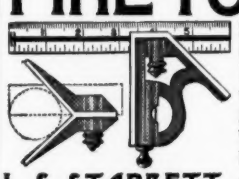

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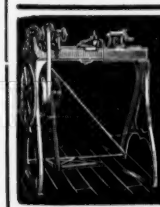

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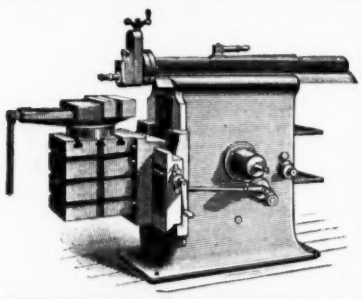

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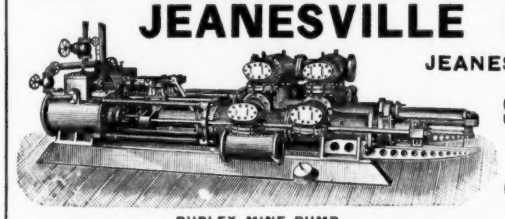

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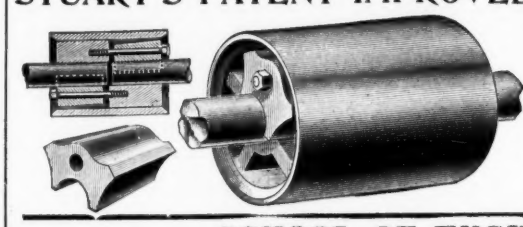

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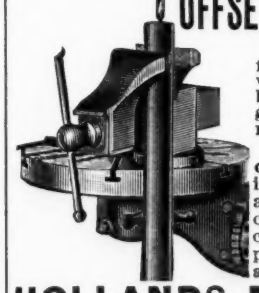

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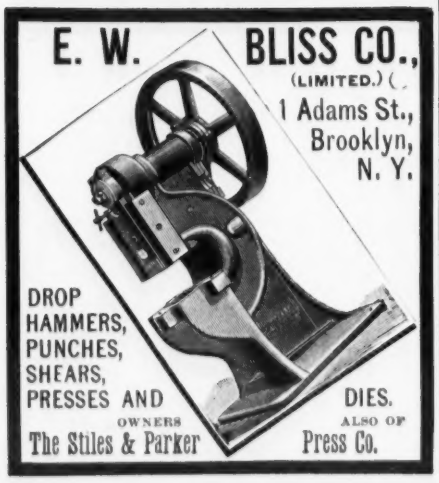

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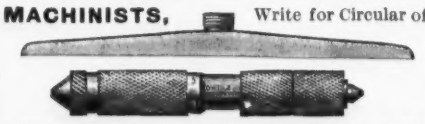

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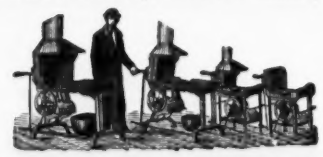

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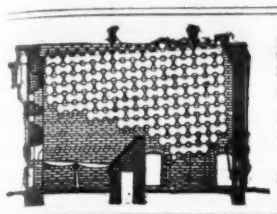

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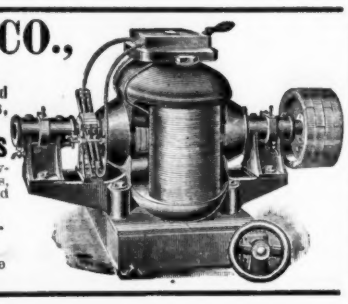

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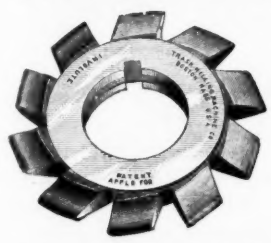

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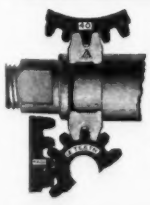

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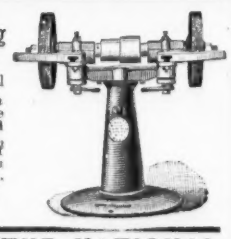

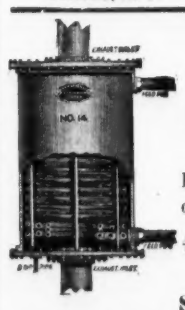

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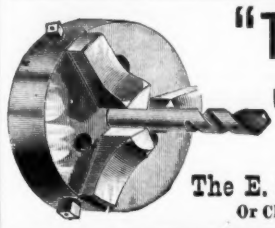

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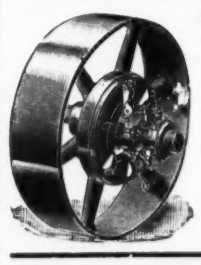

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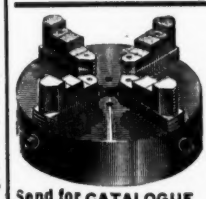

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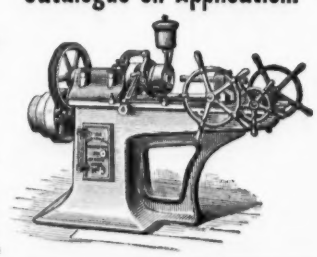

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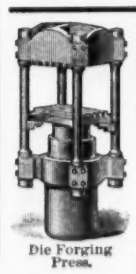

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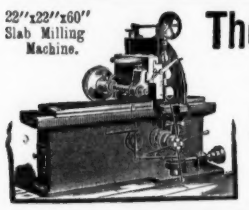

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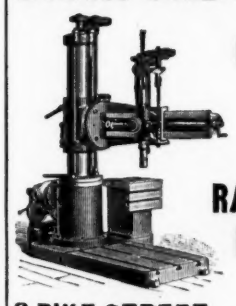

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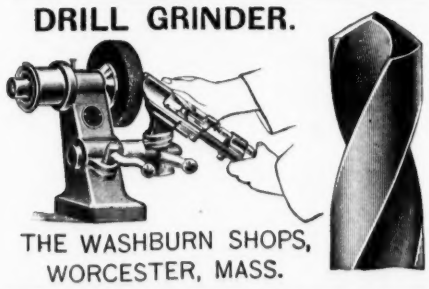

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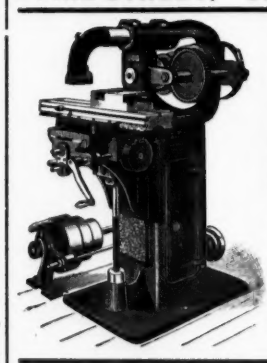

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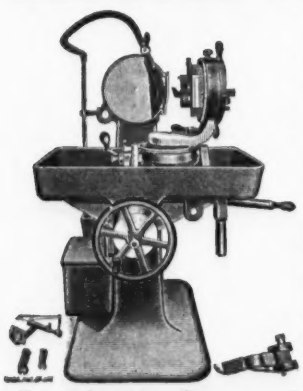

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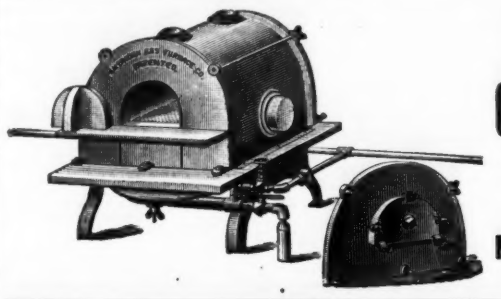

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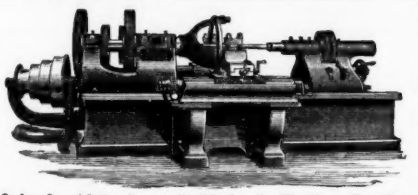

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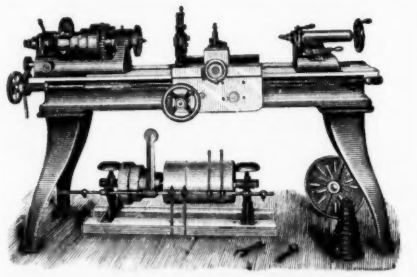

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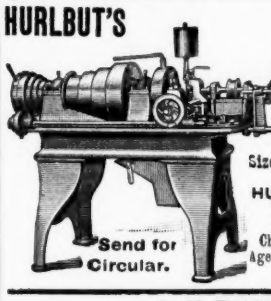

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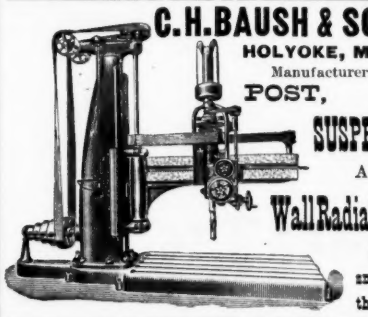

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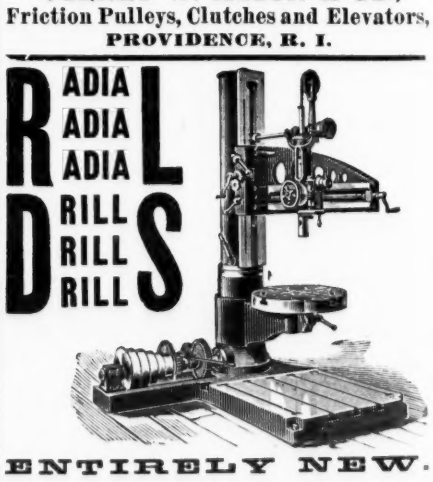

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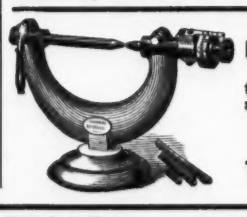

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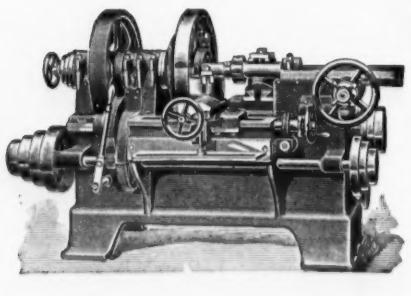

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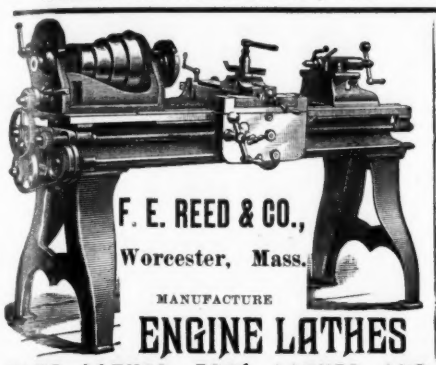

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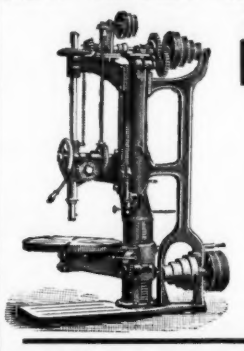

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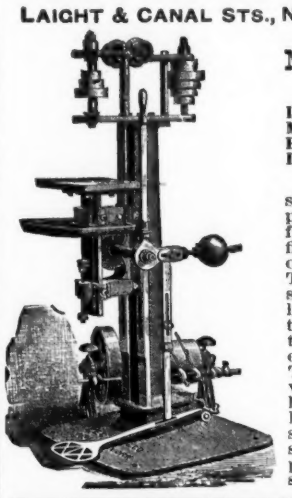

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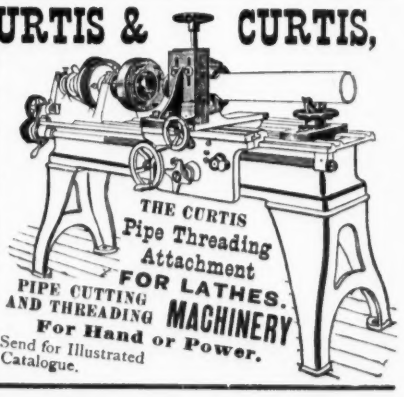

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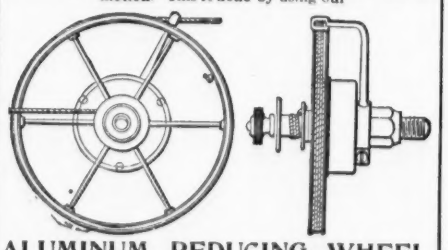
It is necessary to use a perfect method of reducing the motion. This is done by using our



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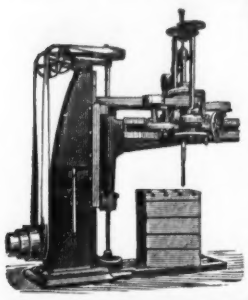

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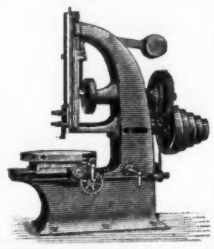

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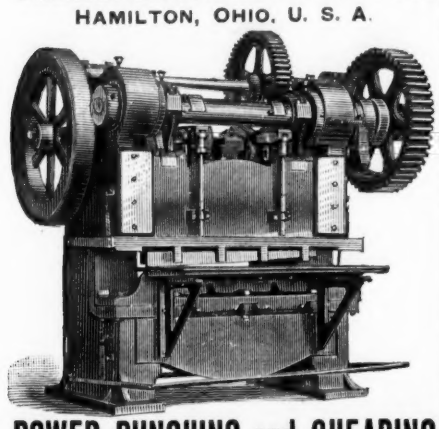

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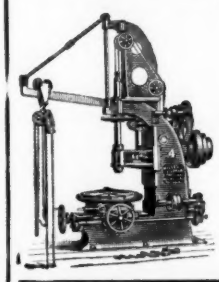

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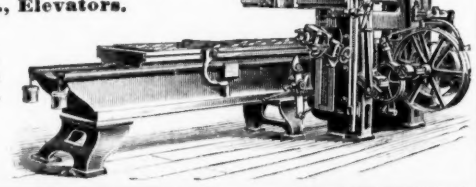

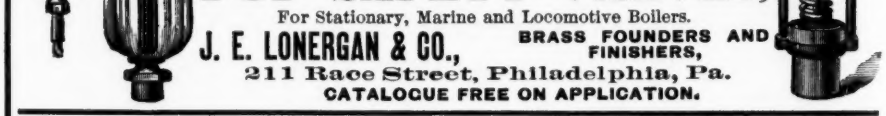

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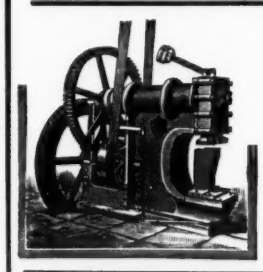

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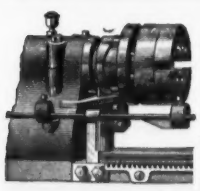

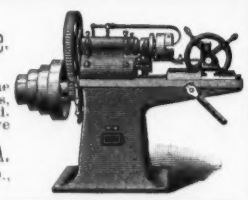

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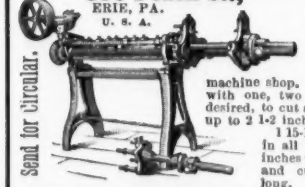

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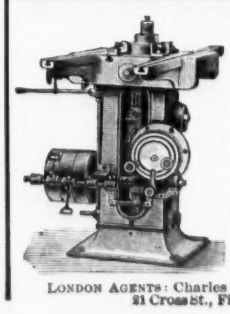

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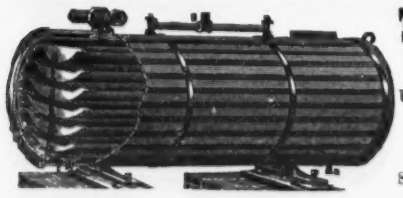

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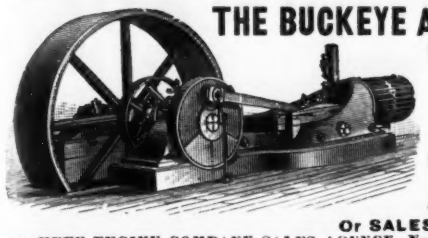

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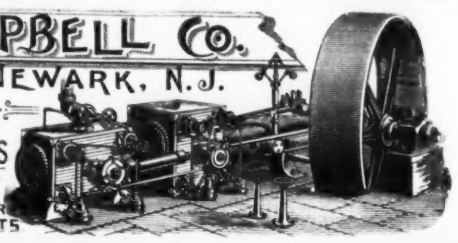

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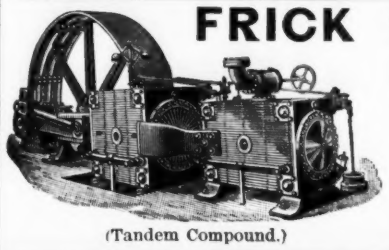

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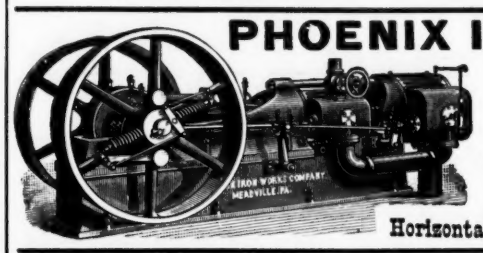

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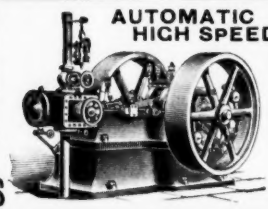

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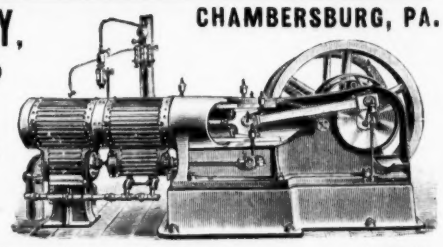

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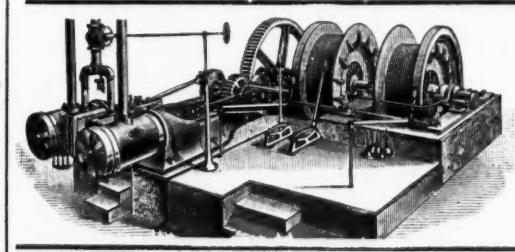

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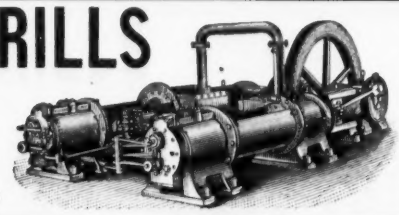

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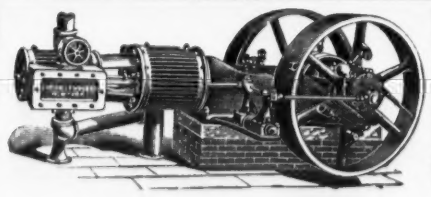

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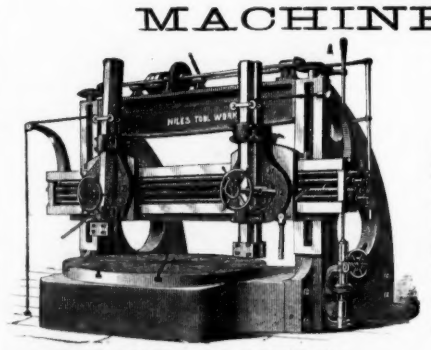

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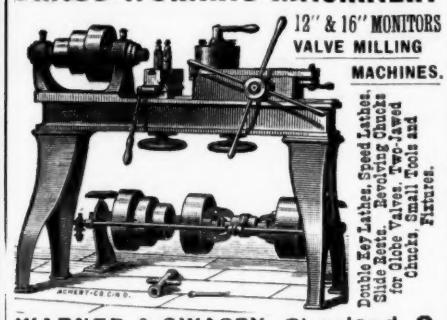
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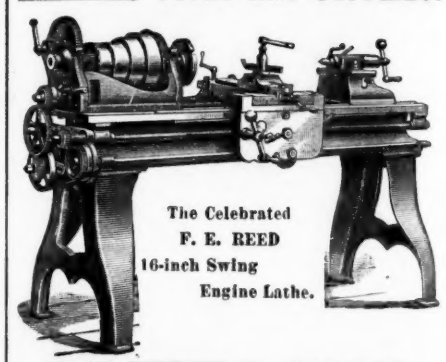

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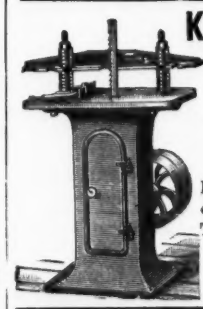

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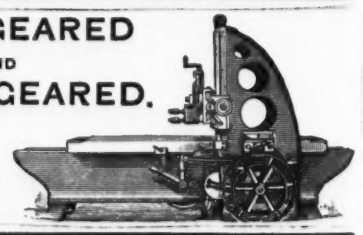

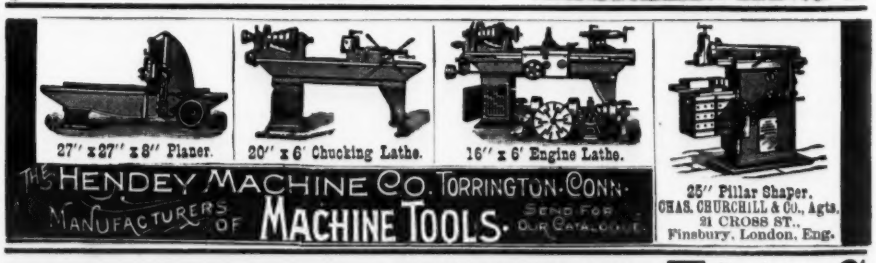
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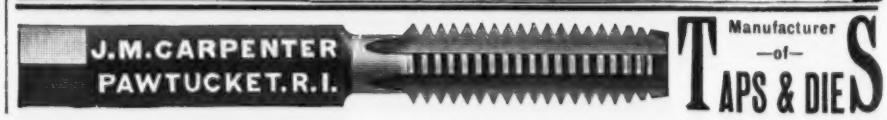

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